

APPENDIX D
WILDLIFE ACCIDENT REDUCTION REPORT

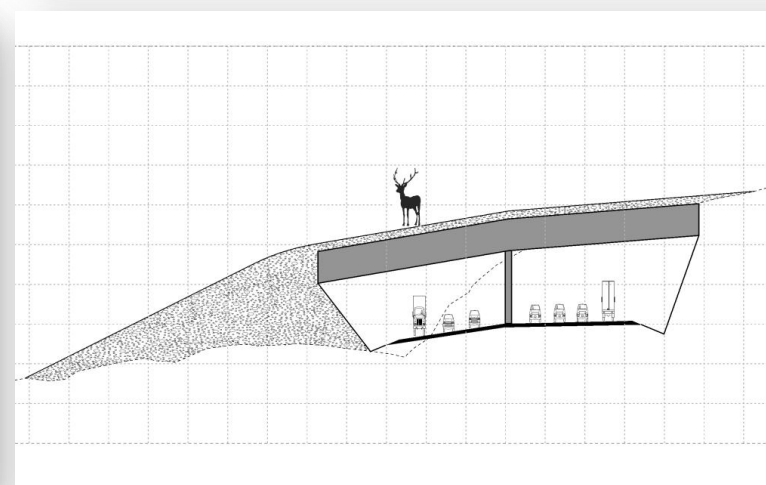
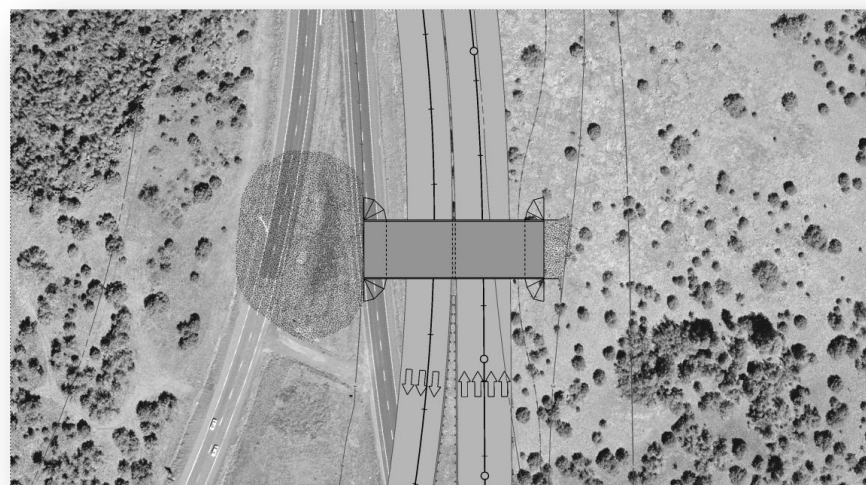


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WILDLIFE ACCIDENT REDUCTION REPORT



I-17, Jct. SR 179 to I-40 MP 298.5-340.0

ADOT Project No. 17 YV 298 H6960 01L
Federal Project No. NH-017-B(AUC)

Cordes Junction – Flagstaff Highway

September 2012

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1.0 Introduction

1.1 Foreword

This report has been prepared to supplement the Final Design Concept Report (DCR) (October 2012) and Final Environmental Assessment (EA) (June 2012) for the Interstate 17 (I-17), Jct. SR 179 to I-40, project. I-17 presently constitutes a barrier to elk movement and roadway widening could worsen the barrier effect. Animals need more time to cross a wider road, and traffic would likely be moving faster on a wider road. Together, these factors increase the probability of wildlife-vehicle crashes.

Agencies that have partnered on this study with the Arizona Department of Transportation (ADOT) and Federal Highway Administration (FHWA) include Arizona Game and Fish Department (AGFD) and the United States Forest Service (USFS) (Coconino National Forest (CNF)).

The purpose of this report is to:

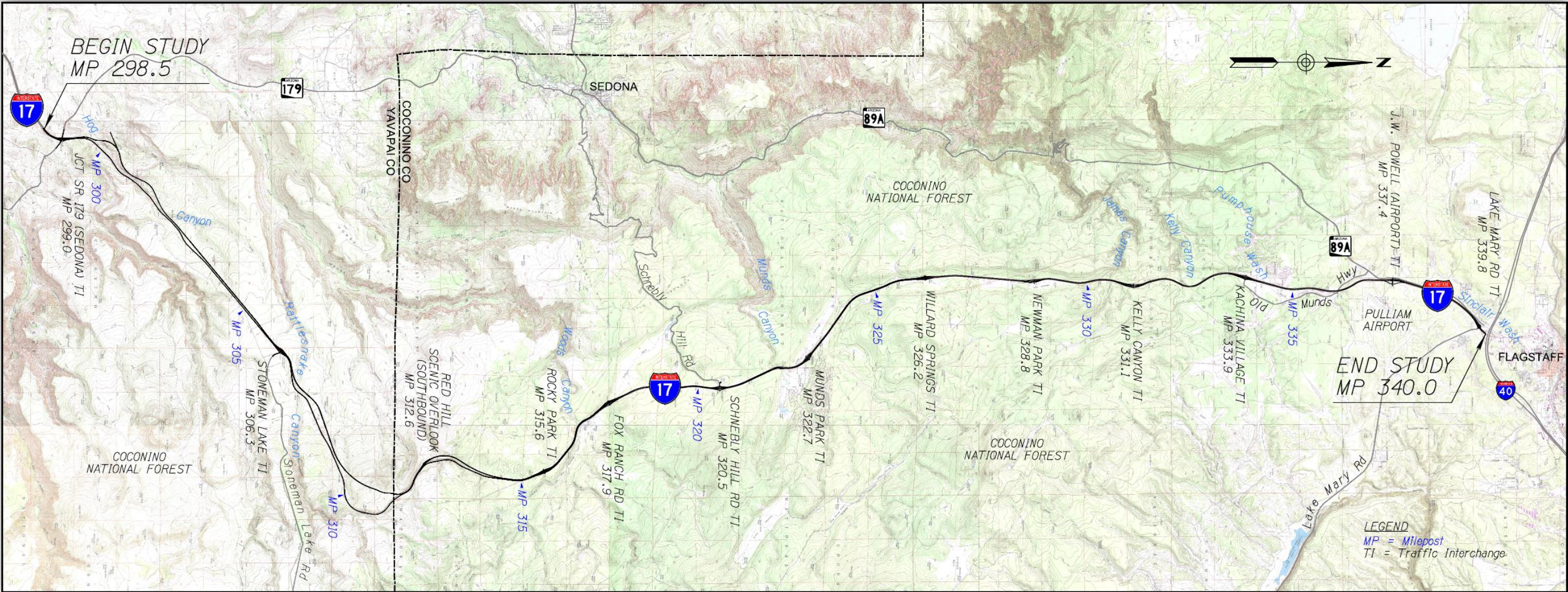
1. Summarize project activities to define opportunities within the project limits that may warrant consideration of wildlife crossing improvements.
2. Provide documentation of specific sites along I-17 identified through agency coordination as potential locations for wildlife crossings.
3. Assess preliminary feasibility, including cost, right-of-way, and environmental impacts, of implementing improvements at each identified location.

4. Determine which elements of the DCR and EA would need to be modified to accommodate wildlife crossing structures and consider alternative structure types at each potential crossing location.
5. Provide future decision-makers with information to establish crossing locations and priorities for structure improvements designed to reduce wildlife/vehicle conflicts and promote wildlife connectivity across I-17.

This report is intended to make preliminary recommendations and provide ADOT, FHWA, CNF, AFGD, and others technical information on the engineering, environmental, cost, and right-of-way impacts of potential wildlife crossing structures.

The DCR and EA study area is shown in Figure 1.

Figure 1 – Vicinity Map



1.2 Initial Design Concept Report

The DCR was developed to document the recommendations of a corridor improvement study for Interstate 17 that encompasses the northern portion of the interstate between the SR 179 (Sedona) Traffic Interchange (TI) at milepost (MP) 298.5 and the I-17/I-40 system interchange in Flagstaff at MP 340.0. The corridor study recommends numerous upgrades to I-17, including widening the northbound (NB) and southbound (SB) roadways to three lanes, providing a northbound climbing lane between MP 299 and MP 314, reconstructing interchanges, and making spot improvements.

Chapter 4 of the DCR describes the Preferred Alternative. For the purpose of cost estimating, it was assumed that the wildlife crossing alternatives, if constructed, would be constructed with the Final Design Concept Report Preferred Alternative.

Estimated costs and potential environmental and right-of-way impacts for wildlife crossing structures identified in this study were measured against the potential impacts that would already be associated with the DCR improvements. They represent incremental costs and impacts over the DCR preferred alternative.

Many of the environmental impacts associated with the wildlife crossings evaluated in this report have been adequately addressed in the EA prepared in concert with the DCR. The majority of the recommended improvements occur within the right-of-way previously considered in detail for all sensitive resources within the project corridor. However, due to the differences from the areas of excavation and fill considered in the DCR and EA to accommodate wildlife crossing improvements, the evaluation associated with this report also considers added potential to impact previously-identified cultural resources.

2.0 Background

2.1 Crash Data

Both ADOT and AGFD collect wildlife collision data. The I-17 Preliminary Traffic Report (November 2007) contained an evaluation of wildlife crashes in ADOT's records along I-17 gathered between March 2001 and February 2006. This data is included in Appendix W1 and summarized as follows: Approximately 79% of crashes with wildlife in the northbound direction did not result in injury to the motorist. Approximately 80% of crashes with wildlife in the southbound direction are No Injury type crashes. There were no fatalities associated with crashes with wildlife within the study section during the five-year evaluation period.

Approximately 51% of the Wild Animal/Game crashes in the northbound direction between MP 310 and MP 324 and 62% of the Wild Animal/Game crashes in the southbound direction occur between MP 310 and MP 324.

Seasonal data indicates that crashes with Wild Animals/Game generally peak in late spring/early summer

AGFD collected wildlife crash data along I-17 from 2007 to 2008; this data is also contained in Appendix W1.

Wildlife/vehicle crashes have historically increased at several locations along the corridor that correspond with riparian meadows and water sources, features that provide attractive grazing habitat for elk and other large ungulates. Locations of these features include:

- Rocky Park (MP 315.2 - MP 316.0)
- Skeleton Park/Munds Canyon (MP 321.0 - MP 322.0)
- Willard Springs Meadow (MP 327.8 - MP 328.6)
- Newman Park (MP 328.8 - MP 329.5)
- Pumphouse Wash (MP 334.0 - MP 334.8)

Wildlife crashes are also generally more prevalent in the higher elevations north of the Mogollon Rim, between MP 312 and Flagstaff.

2.2 Arizona Game and Fish Department Elk Research

Work on a research study was initiated by AGFD in 2008 to assess elk movement patterns and distribution relative to I-17 to identify the location of high-frequency crossing zones and assess elk permeability across the

highway corridor. AGFD published its research findings in the report *Elk Movements Associated With a High-Traffic Highway: Interstate 17, Final Report 647*, September 2011.

AGFD uses GPS telemetry and employs scientific methodologies to assess movements, distribution, and measure elk permeability. The AGFD research study may help verify whether the potential locations identified during this study are supported by real-world data and provide a scientific foundation for locating wildlife crossing structures.

2.3 Meetings and Field Reviews

Three formal multi-agency field review meetings were held in support of this Wildlife Accident Reduction Report. The meetings were held on December 18, 2007, April 23, 2009, and June 28, 2011. Additionally, three office meetings were held to discuss wildlife connectivity on April 21, 2008, March 17, 2010, and June 1, 2011. Minutes for all six meetings and the handout prepared for the April 23, 2009 field review are included in Appendix W4.

The field reviews consisted of team members conducting a focused evaluation of the project corridor and discussing how wildlife crossing structures could be incorporated into the proposed highway improvements. Team members identified issues, concerns, and opportunities at specific locations and for general wildlife connectivity considerations throughout the corridor. Evaluation criteria emphasis was placed on:

1. Modifying existing culvert and bridge structures to encourage wildlife passage under I-17.
2. Identifying locations that could be suitable for wildlife passage structures over I-17.
3. The importance of wildlife-proof fencing to direct animals to the crossing structures.

In addition to collaborating on potential structure locations, AGFD provided the study team with guidelines for the design of wildlife crossings, including the following elements:

General

- A maximum structure spacing of 2.2 miles is recommended. If structures are spaced at wider intervals, the probability of elk moving laterally to use a structure decreases and the likelihood of at-grade highway crossings increases.
- Separation between roadways and wildlife pathways is desirable.
- Monitoring systems should be included to evaluate performance.

Fencing

- Add wildlife-proof fencing to channel wildlife to crossing structures.
- Include wildlife ramps and jumps to allow trapped animals to escape from within the roadway side of the wildlife fencing.
- Evaluate locations of ends of wildlife fencing so that animals don't walk around the end of the fence to the road side.

Underpasses

- Provide an earthen-surfaced floor of the crossing structure, avoiding ledges and riprap where possible.
- Site wildlife pathways above the channel to allow passage separate from drainage flows.
- A wider, taller, brighter opening provides a more appealing crossing versus a narrow, low, dark space.
- Sight lines for animals approaching the structure should be adequate to see the other side.
- Past AGFD research indicates open-span bridges are superior to culverts for facilitating elk passage.
- Fencing will be placed in the median, linking northbound and southbound lane underpasses.
- Where culverts/arches are used, deeper levels of soil between the roadway and the top of the culvert will dampen noise when vehicles pass overhead.

Overpasses

- The structure deck should be covered with native soils and vegetation.
- Sight lines for animals approaching the structure should be adequate to see the other side.
- Fencing should be included on the structure and approaches.
- Approaches should shield headlights and road noise as much as possible.

Shared-Use TIs

- Provide a landscape buffer between the roadway and wildlife path.
- Human activity and idling trucks are undesirable to wildlife.

3.0 Wildlife Crossing Structures

3.1 Introduction

Three types of wildlife crossing structures were considered:

- **Wildlife overcrossings** – landscaped bridges designed exclusively for wildlife passage above I-17
- **Wildlife undercrossings** – structures designed to accommodate wildlife passage and possibly storm water drainage under I-17
- **Shared-use TI** – a low-volume traffic interchange that would be modified to encourage wildlife to cross I-17 on or next to the cross road

Table 1 contains a list of each location and type of potential wildlife structure evaluated in this report. These locations were developed based on crash data, AGFD's ongoing elk research study, and migration routes. Terrain features were key factors in the selection of potential crossing locations to improve feasibility. Most underpasses were proposed at large drainages; cut slopes were preferred for overpass sites.

Wildlife crossing structures were designed for large ungulates (e.g. elk, deer). Other than recommending fencing to guide wildlife to recommended crossing locations, specific needs for other, smaller animals are not addressed.

Potential visual impacts associated with wildlife overpasses were evaluated with the study and a summary of potential mitigation measures is included in the project's environmental assessment. Coordination with CNF will be required to ensure visual mitigation measures as stated in the Final EA, such as irregular clearing limits, varying slope rates, and saving vegetation, are adequately incorporated into the design of wildlife crossing structures.

Table 1 – Locations Evaluated for Wildlife Crossing Structures

Crossing No.	Location	Description	Potential Wildlife Crossing Structure Type
1	MP 306.3	Stoneman Lake Road TI	Shared-use TI
2A	MP 307.0	Cut Slope South of Rattlesnake Canyon	Overcrossing
2B, 2C	MP 307.2	Rattlesnake Canyon	Undercrossing
3	MP 309.8 (SB)	Wide Median	Overcrossing
	MP 310.2 (NB)		Undercrossing
4	MP 311.7	Southbound Scenic Overlook	Overcrossing
5	MP 314.4	Rocky Park Meadow	Overcrossing
6	MP 315.6	Rocky Park TI	Shared-use TI
7	MP 317.0	Woods Canyon Bridge	Undercrossing
8	MP 319.2	Skeleton Park	Undercrossing
9	MP 320.5	Schnebly Hill Road TI	Shared-use TI
10	MP 322.0	Munds Canyon Bridge	Undercrossing
11	MP 323.4	Munds Wash	Undercrossing
12	MP 324.4	Munds Ranch Road	Undercrossing
13	MP 326.2	Willard Springs TI	Shared-use TI
14	MP 327.4	Willard Springs Meadow	Overcrossing
15	MP 328.8	Newman Park TI	Shared-use TI
16	MP 330.3	James Canyon Culvert	Undercrossing
17	MP 331.1	Kelly Canyon TI	Shared-use TI
18	MP 332.3	Kelly Canyon Culvert	Undercrossing
19	MP 333.1	South of Kachina Village	Overcrossing
20	MP 334.3	Pumphouse Wash	Undercrossing
21	MP 336.1	Old Munds Highway	Undercrossing

3.2 Wildlife Fencing, Escape Ramps, and Gates

Wildlife fencing describes any natural or man-made barrier to ungulates. Examples include tall right-of-way fencing, a wide line of large riprap, and steep cut sections. Wildlife fencing is recommended to keep wildlife off the roadway and channeled to safer, grade-separated wildlife crossing structures.

Construction on a project to install wildlife fencing along I-17 from Munds Canyon to Woods Canyon began in Summer 2011. The project, H7740 Woods Canyon Bridge to Munds Park TI (MP 316.8 – MP 322.72), is a transportation enhancement project that also includes bridge rail upgrades at Fox Ranch TI. Post-construction AGFD observation of the wildlife fencing will help determine its effectiveness and will be used to validate or recommend changes to future wildlife fencing installations.

This project recommends retaining the new (Summer 2011) fencing from MP 316.8 to MP 322.72 and extending it south to Stoneman Lake TI (MP 306.3) and north to Lake Mary Road TI (MP 339.7). It is assumed for this report that the wildlife fencing between MP 316.8 and 322.7 is effective and additional installation throughout the corridor would be appropriate.

The cost estimate for this project includes eight-foot-high wire mesh wildlife fence along both sides of the ADOT right-of-way from the Stoneman Lake TI (MP 306.3) to Woods Canyon (MP 316.8) and from Munds Canyon (MP 322.7) to Lake Mary Road TI (MP 339.7).

Since animals may become trapped on the roadway side of the fence, intermittent escape ramps or jumpouts should be provided. Periodic gates are desirable for fence maintenance but should not be used for forest access. The cost estimate includes escape ramps at 0.5-mile intervals plus four at each wildlife crossing and gates at one-mile intervals.

According to CNF, the highway currently serves as a seasonal boundary for livestock grazing and that if a wildlife crossing is installed it would connect separate grazing areas. During the short (typically 30-45 days) periods when livestock are present, a fence across the wildlife crossing would be required to contain cattle.

The cost for each segment of wildlife fencing, including escape measures, was assigned to each wildlife crossing structure cost estimate based on a prorated length from the midpoint to the previous and following structures. Estimated costs are detailed in the evaluation matrix in Section 3.6 and in Appendix W3.

3.3 Wildlife Undercrossing Structures

3.3.1 Introduction

The following potential wildlife undercrossing structures have been evaluated with the study:

- Rattlesnake Canyon (SB MP 307.1 and NB MP 307.4)
- Rattlesnake Canyon (SB MP 307.2 and NB MP 307.4)
- Wide Median (NB) (MP 310.2)
- Woods Canyon Bridge (MP 317.0)
- Skeleton Park (MP 319.2)
- Munds Canyon Bridge (MP 322.0)
- Munds Wash (MP 323.4)
- Munds Ranch Road (MP 324.4)
- James Canyon (MP 330.3)
- Kelly Canyon (MP 332.3)
- Old Munds Highway (MP 336.1)

All locations except Old Munds Highway coincide with a drainage course and may need to be designed to properly convey storm flows in addition to wildlife passage. These underpasses could be dual-use wildlife/drainage structures that serve the needs of both wildlife and stormwater management. The last location, Old Munds Highway, is a vehicle grade separation.

In both cases, combining the functional needs of wildlife connectivity with either stormwater management or vehicle transportation would be more cost effective than constructing separate structures for individual uses.

3.3.2 Rattlesnake Canyon (MP 307.1 – MP 307.4)

I-17 crosses above Rattlesnake Canyon on embankment approximately 100 feet above the drainage channel. Drainage is conveyed under each roadway through twin 12-foot diameter pipe culverts at southbound MP 307.1 and northbound MP 307.3.

Upstream of the drainage structures at southbound MP 307.2 and northbound MP 307.4, and higher in the roadway embankment, are 10x10-foot box culverts, one under each roadway, that serve as part of a “sheep driveway.”

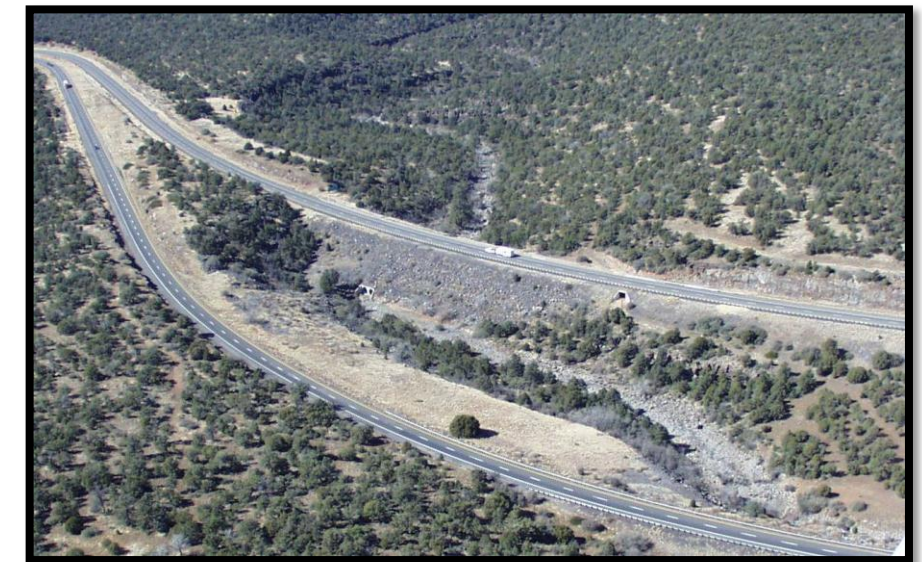


Photo 1. Rattlesnake Canyon, facing west from upstream of I-17.

The DCR recommends adding two additional lanes to the northbound roadway and one additional lane to the southbound roadway in this segment of I-17. Widening would be accomplished by adding embankment to each roadway and lengthening both the 12-foot diameter pipes and 10x10-foot box culverts.



Photos 2 and 3. Rattlesnake Canyon, twin 12-foot pipes (left) and 10x10-foot box culverts (right) are unsuitable for elk use due to their confined opening size and length. To facilitate a wildlife crossing structure at this location, a larger cross-sectional opening is recommended.

Two alternatives were developed for a wildlife undercrossing at this location.

Concrete Arch Alternative (SB MP 307.1 and NB MP 307.4)

One alternative is to construct two concrete arch structures, one under each roadway, at southbound MP 307.1 and northbound MP 307.4. The structures would be placed above the drainage pipes, higher in the embankment. The structures would provide a wildlife crossing 48 feet wide and 12 feet tall. The length of the northbound structure would be 205 feet and the length of the southbound structure would be 180 feet.

The estimated cost for the concrete arch wildlife undercrossing structure alternative at this location, including associated fencing, is \$10,500,000.

Single-Span Bridge Alternative (SB MP 307.2 and NB MP 307.4)

The second alternative for a wildlife crossing structure is to remove the 10x10-foot box culverts and replace them with single-span roadway bridges for wildlife and livestock passage. Embankment under the new bridges would be removed to provide an opening for wildlife and livestock passage 25 feet wide with 2:1 (slope rate of 2 horizontal to 1 vertical) abutment foreslopes and 15 feet of vertical clearance. The crossing would not be designed for drainage; storm flows would be accommodated through extended 12-foot diameter pipes.

This location may impact a nearby archaeological site. There would be no visual impacts.

The estimated cost for two single-span bridges, one at southbound MP 307.2 and one at northbound MP 307.4, including fencing and escape measures assigned to this area is approximately \$6,400,000.

Based on the preliminary concepts and evaluation, the single-span bridge alternative is recommended. The concrete arch alternative was not recommended for the following reasons:

- The concrete arch culvert dimensions may result in an undesirable “tunnel-like” cross-sectional opening less conducive for wildlife passage than the sloped end spans, open median, and shorter length of the single-span bridge alternative.
- The concrete arch alternative has a higher estimated construction cost.

3.3.3 Wide Median (NB) (MP 310.2)

This location would construct two wildlife crossing structures. This section describes a proposed wildlife undercrossing at northbound MP 310.2. Section 3.4.3 describes a proposed wildlife overcrossing at southbound MP 309.8. Together, the two structures, along with fencing connecting them through the wide median, could provide connectivity across I-17.

The proposed wildlife undercrossing structure at northbound MP 310.2 is a single-span bridge that would replace a shallow embankment and small (24-inch) pipe culvert.

The area under the bridge would be excavated to create a wildlife path 40 feet wide with 2:1 abutment foreslopes and 12 feet of vertical clearance.

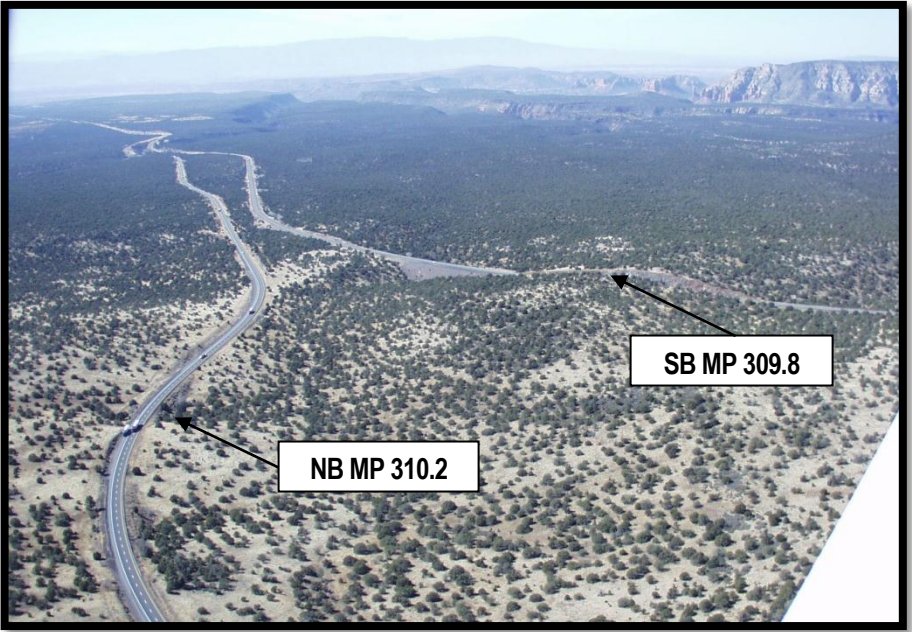


Photo 4. Wide median area near MP 310, looking southwest

The proposed crossing would require reshaping of the terrain around the east approach to provide 12 feet of vertical clearance and improve the line of sight through the structure. The west approach would blend in with the adjacent terrain.

The estimated cost for this wildlife crossing structure, including the complementary structure at southbound MP 309.8 and associated fencing, is \$6,800,000.

3.3.4 Woods Canyon Bridges (MP 317.0)

The existing Woods Canyon bridges have adequate dimensions to provide opportunities for wildlife to cross under I-17.



Photo 5. Looking west, Woods Canyon’s steep slopes appear in the top half of the photo, and the flat meadow east of I-17 is visible in the bottom half.



Photo 6. Woods Canyon bridges, looking west. The structures each have three spans with center spans over 60 feet long, 1.5:1 abutment foreslopes, and approximately 20 feet of vertical clearance. There are stabilized riprap foreslopes in front of each abutment. Large boulders are scattered throughout the area under and downstream of the structures.

The DCR recommends replacement of the northbound bridge and widening of the southbound bridge. Both bridges would be designed for roadways 60 feet wide. This configuration would leave the cross-sectional opening under the structures virtually unchanged, but length would be added to the crossing path under each roadway bridge.

While a wildlife path above the low-flow channel may be desirable to facilitate wildlife passage during storm events, improvements beyond those proposed in the DCR are not recommended.

The estimated cost for the wildlife undercrossing elements, including associated fencing, is \$500,000.

3.3.5 Skeleton Park (MP 319.2)

Skeleton Park is one of several locations with a water/meadow feature associated with elk activity and a high wildlife-vehicle crash rate. The existing 8x7-foot box culvert at MP 319.2 was identified as a high priority for retrofit into a wildlife crossing structure.

The culvert is perpendicular to I-17 and 170 feet long. To alleviate potential overtopping of the roadway by storm flows, the DCR recommends that a 78-inch diameter pipe culvert be added at this location.

Two alternatives for a wildlife crossing structure were developed at this location. Both would remove the box culvert and replace it with a larger undercrossing structure.

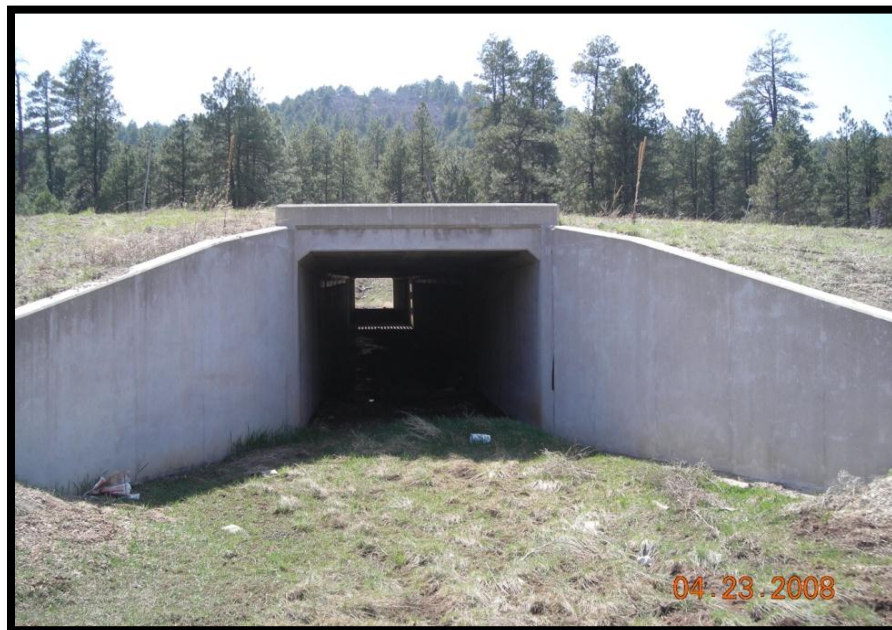


Photo 7. 8x7-foot box culvert at Skeleton Park, looking west

To provide vertical clearance for wildlife, the mainline roadway profile will need to be raised between five feet and eight feet. A natural, earthen floor is desirable for wildlife passages. Each side of the opening should blend in to the adjacent terrain as much as possible.

Concrete Arch Alternative

One option is a concrete arch structure. The concrete arch alternative would provide a width of 48 feet and height of 12 feet. The length would be 210 feet – enough for the northbound and southbound roadways (60 feet each), median (52 feet), roadway barriers, and side slopes. It is practical to offset the roadway barriers from the edge of the culvert to avoid the need to consider vehicle impact loading with the headwall design.

An opening in the top of the culvert could be included. Coupled with a vehicle-proof grate flush with the median, the opening would allow natural light to illuminate the crossing path.

I-17 would need to be raised approximately eight feet to clear the arch structure. This would require a gradual profile change that would extend approximately one-quarter mile from each end of the structure. An estimated 100,000 cubic yards of embankment material would need to be imported.

The estimated cost for this wildlife undercrossing structure, including associated fencing, is \$4,900,000.

Single-Span Bridge Alternative

Another structural option is single-span concrete bridges. The single-span concrete bridge alternative proposes 100-foot long structures that would provide a wildlife path 40 feet wide with 2:1 abutment foreslopes and 12 feet of vertical clearance.

An open median is more desirable for wildlife connectivity but requires roadway barrier to shield the median opening between the northbound and southbound structures. Approximately 500 feet of additional guardrail is required at the approach to each bridge.

I-17 would need to be raised approximately 10 feet to provide 12 feet of vertical clearance. This would require a gradual profile change that would extend approximately one-quarter mile from each end of the structure. An estimated 125,000 cubic yards of embankment material would need to be imported.

The structure would not impact visual quality or cultural sites.

The estimated cost for this wildlife undercrossing structure, including associated fencing, is \$4,400,000.

Based on the preliminary concepts and evaluation, the single-span bridge alternative is recommended. The concrete arch alternative was not recommended for the following reasons:

- The concrete arch culvert dimensions may result in an undesirable “tunnel-like” cross-sectional opening less conducive for wildlife passage than the sloped end spans, open median, and shorter length of the single-span bridge alternative.
- The concrete arch alternative has a higher estimated construction cost.

3.3.6 Munds Canyon Bridge (MP 322.0)

The existing Munds Canyon crossing is a structure that functions well as a wildlife crossing. The bridge spans are open, the substrate consists of

natural terrain, and visibility along the crossing path is adequate for wildlife.

As previously mentioned, ADOT is currently constructing a project to install wildlife fencing from Woods Canyon to Munds Canyon. The fencing is intended to guide animals to use this and other specified locations to cross I-17.



Photo 8. Munds Canyon bridges, looking west

The DCR recommends widening the existing Munds Canyon structures to accommodate a third mainline lane in each direction. Temporary fill material would be placed in Munds Wash to support cast-in-place bridge construction. Since the temporary material would be removed after construction, Section 404 impacts are anticipated to be minimal.

This location would not impact visual quality or cultural sites.

Fencing to the north would help ensure this location operates as a successful wildlife passage structure and is estimated to cost \$500,000.

3.3.7 Munds Wash (MP 323.4)

Munds Wash crosses under I-17 through dual 10x10-foot box culverts approximately 0.5 mile north of the Munds Park TI. The area around this culvert is one of several locations identified as a water/meadow feature associated with elk activity. The proximity of the Munds Park TI at MP 322.7 detracts from the suitability of this location since the interchange is associated with development, trucks, and other noise that could make the area less desirable for elk.

The culvert has a 30-degree skew and length of 210 feet. The DCR proposes lengthening the culvert to 255 feet. A supplemental box culvert

would be constructed adjacent to the existing box culvert per the DCR. The additional culvert would be 3-10x8, resulting in an overall layout that includes five box culvert cells.

To provide a wildlife crossing structure at this location, the existing dual box culvert would remain and a new concrete arch structure would be constructed parallel to the existing structure. The cross-sectional opening of the new structure would provide supplemental drainage capacity and wildlife passage. This alternative proposes a concrete arch structure with a span of 48 feet and height of 12 feet. The length of the culvert would be 255 feet.



Photo 9. Munds Wash 2-10x10-foot box culvert, looking west. Visible through the culvert is a steep cut slope, a potential line-of-sight restriction at this location.

I-17 would need to be raised by approximately five feet to accommodate the taller structure. This would require a gradual profile change that would extend approximately one-quarter mile from each end of the structure. Embankment material would need to be imported.

The estimated cost for this wildlife undercrossing structure would be \$4,600,000. Fencing was not assigned to this location since the wildlife crossing is not recommended – fencing in this area is assigned to nearby recommended structures.

Based on this preliminary concept and evaluation, this location is not recommended as a wildlife passage structure for the following reasons:

- Lower likelihood elk will use the adjacent area if development near Munds Park TI expands.
- Lower likelihood of elk usage due to long crossing length.
- Potential 4(f) concerns from adjacent historic property.
- Nearby potential wildlife crossing structures at MP 322.0 and MP 324.4 are recommended.

3.3.8 Munds Ranch Road (MP 324.4)

Munds Ranch Road is an unpaved, very low-volume forest service road. It crosses under I-17 through a box culvert that is 15 feet high, 15 feet wide, and 175 feet long.

The DCR recommends this structure be removed and replaced with a single-span slab bridge and vertical abutments for both northbound and southbound roadways. A cross-sectional area 22 feet wide and 14.5 feet tall would be provided for Munds Ranch Road and drainage flows.

The proposed alternative for a wildlife crossing at this location is a combined crossing for both vehicles and wildlife. The dimensions as proposed in the DCR would be used. Fencing would be included to guide wildlife to cross at this location. If practical, an earthen roadway surface through the crossing could be provided for wildlife.

A 50-foot wide open median between the northbound and southbound bridges would allow natural light in, although it would expose wildlife to more undesirable vehicle noise than an enclosed structure.



Photo 10. Munds Ranch Road 15x15-foot box culvert, looking west

These modifications would not impact visual quality or cultural sites.

New right-of-way is not required for this alternative. The estimated cost for the wildlife crossing elements is \$1,700,000. The cost is related to fencing and escape elements as there is no change to the DCR structure cost.

3.3.9 James Canyon Culvert (MP 330.3)

I-17 crosses James Canyon at a 20-degree skew on 50 feet of embankment fill. Drainage flows are conveyed through a twin 10x8-foot box culvert 240 feet long.

The DCR recommends adding one lane in each direction and raising the grade of I-17 approximately eight feet at the James Canyon sag vertical

curve to improve headlight sight distance. With the roadway elevated and widened to the outside, the culvert would be extended on both sides and potentially reinforced to support a taller and wider highway embankment.

The proposed alternative for a wildlife crossing structure at this location is to add separate single-span bridges for each direction of I-17 and excavate the area underneath the bridges to create a wildlife path 40 feet wide and 14 feet of vertical clearance with 2:1 abutment foreslopes. With I-17 raised eight feet, there would be sufficient vertical clearance to fit the wildlife crossing path completely above the level of the existing box culvert. This concept would retain the existing box culvert and use it to convey drainage, thereby separating the wildlife path from storm flows.



Photo 11. James Canyon, looking west

Positioning the wildlife crossing structures above the box culvert eliminates the potential need to reinforce the existing box culvert for additional embankment loading and lessens the need to extend the box culvert to support a wider roadway embankment.

The approach to each end of the crossing should have a clear line of sight through the crossing. In addition to ensuring adequate riprap or bank protection for storm flows, the grading on each side would need to provide a suitable wildlife approach with desirable slopes 5:1 or flatter. The need for new right-of-way is not anticipated for this alternative.

These modifications would not impact visual quality or cultural sites.

The estimated cost for this wildlife crossing structure alternative and associated fencing is \$4,600,000.

3.3.10 Kelly Canyon Culvert (MP 332.3)

I-17 crosses Kelly Canyon with no skew on 30 feet of embankment fill. Drainage flows are conveyed through an 84-inch diameter pipe culvert that is 266 feet long. This location was identified as a potential candidate for retrofit into a wildlife/drainage structure to provide continuity along the canyon. Another potential wildlife crossing is located 0.8 mile to the north.

Large debris above the culvert inlet suggest the need for additional drainage capacity. This was confirmed by the DCR recommendation to add a parallel, slightly smaller 78-inch diameter pipe culvert to improve drainage capacity.



Photo 12. Kelly Canyon 84-inch diameter pipe culvert, looking west

The proposed wildlife crossing at this location would remove the pipe culvert and add a single-span bridge for I-17 in each direction. Structures that are 120 feet long with 2:1 side slopes are proposed to provide an open undercrossing with space for both drainage and wildlife. The alternative includes a 10-foot wide elk pathway 5 feet above the drainage channel, within the 2:1 abutment foreslope. Fifteen feet of vertical clearance would be provided above the elk pathway.

Large boulders at each approach present a barrier to elk. Similar to the wildlife crossing structure proposed at James Canyon, a traversable approach with a clear line of sight would be included at each end.

Construction of this alternative would likely require that both directions of I-17 traffic be diverted to one roadway while the other is removed, the material underneath is excavated, and the new structure is constructed.

Construction of bridges at this location would require more time than would be needed for the DCR-recommended improvements. The longer duration is undesirable at this location specifically due to the numerous horizontal curves and relatively steep vertical grades that could complicate median crossover design.

The structure would not impact visual quality or cultural sites.

The need for new right-of-way is not anticipated. The estimated cost for a wildlife crossing structure at this location is \$5,400,000.

Based on the preliminary concept and evaluation, this location is not recommended as a wildlife passage structure for the following reasons:

- Incrementally longer structures are required at this location to span canyon than other undercrossing alternatives.
- High design and operational complexity at this site due to geometrics of mainline.
- Potential wildlife crossing structures nearby at MP 330.3 and MP 333.3 are recommended.



Photo 13. Boulders upstream of Kelly Canyon 84” diameter pipe culvert, looking east

3.3.11 Pumphouse Wash (MP 334.3)

Pumphouse Wash is conveyed under I-17 via a 200-foot-long triple 10x12-foot box culvert.



Photo 14. Pumphouse Wash 3-10x12-foot box culvert

This location was identified as a potential wildlife crossing opportunity to connect the large meadows on both sides of I-17 that offer suitable habitat for elk.

The DCR recommends improvements to drainage capacity by the addition of a supplemental triple 10x10-foot box culvert at this location.

Although the location currently is suitable for wildlife, the close proximity of the Kachina Village TI (1000 feet south) and presence of private land increases the likelihood of ongoing human development that would decrease the future suitability of the area for elk.

Vertical clearance needs, including potentially raising I-17, would need to be evaluated. Because there is little existing vertical separation between the box culvert and top of pavement, I-17 may need to be elevated ten feet or more to provide structural thickness and vertical clearance which may impact the northern Kachina Village interchange ramps.

While the need to upsize the existing drainage structure presents a good opportunity to design for wildlife connectivity, this location was eliminated from consideration as a wildlife crossing structure because of adjacent development.

3.3.12 Old Munds Highway (MP 336.1)

Old Munds Highway is an unpaved Coconino County urban collector road that crosses under I-17 through a box culvert 15 feet high, 15 feet wide and 178 feet long. The existing northbound and southbound roadways cross several feet above the top of the box culvert. There is no median opening.

This location is the northernmost potential wildlife crossing structure evaluated and was selected to provide a crossing between Kachina Village and Flagstaff.

The DCR recommends removal of the existing structure and replacement with a single-span slab bridge in each direction spanning 30 feet with vertical abutments. Vertical abutments are recommended to minimize the span length, allowing the use of a slab bridge. A slab bridge is desirable since it is thin enough to provide 14.5 feet of vertical clearance while avoiding the need to raise I-17 or lower Old Munds Highway.

The proposed alternative for a wildlife crossing structure at this location is to design Old Munds Highway for both vehicles and wildlife at the crossing under I-17. The structure dimensions proposed in the DCR would be used – 30 feet wide by 14.5 feet. Fencing would be included to direct wildlife to cross at this location. If practical, an earthen path through the crossing would be desirable to wildlife.

A 50-foot wide uncovered median between the northbound and southbound bridges would allow natural light in but also would allow more exposure of wildlife to undesirable vehicle noise than an enclosed structure. The median opening will require wildlife fencing to connect the structures.

Sight distance to the east approach is somewhat restricted by the existing hillside. Slope flattening could improve sight distance but would require new right-of-way and therefore is not recommended with this project.

The modifications would not impact visual quality.

The proposed concept would not require new right-of-way and has an estimated cost of \$2,100,000. The cost is limited to fencing and escape elements since there is no change to the recommended DCR concept with this alternative.

3.4 Wildlife Overcrossing Structures

3.4.1 General Features

Wildlife overcrossing structures would consist of landscaped bridges built exclusively for wildlife to cross over I-17. The bridges should have an earthen cover imported from a nearby source and be capable of supporting local vegetation as a means of blending the approaches into the surrounding terrain and providing a natural-looking appearance.

The following potential wildlife overcrossing structures have been evaluated with the study:

- South of Rattlesnake Canyon (MP 307.0)
- Wide Median (SB) (MP 310.2)
- Southbound Scenic Overlook (MP 311.7)
- Rocky Park Meadow (MP 314.2)
- Willard Springs Meadow (MP 327.4)
- South of Kachina Village (MP 333.3)

New structures above I-17 could restrict over-height loads. The following alternatives provide 16.5 feet of vertical clearance over I-17. A buffer to provide clearance in excess of 16.5 feet should be considered since there is no alternate route for an oversized vehicle to bypass the structure as there is with interchanges.

3.4.2 South of Rattlesnake Canyon (MP 307.0)

This potential overcrossing site was identified as an alternative to the two undercrossing alternatives at nearby Rattlesnake Canyon (MP 307.1-MP 307.4). The principal advantage of this concept versus the undercrossing alternatives is that construction could be substantially less disruptive to traffic with a short-term closure required to construct over the existing roadway versus a long-term closure required to construct under the existing roadway.

The proposed alternative for a wildlife crossing structure is a pair of single-span bridges, one above each direction of I-17, at approximately MP 307.0. The bridges would span 110 feet (northbound) and 100 feet (southbound). The structures would be positioned directly opposite each other to optimize the line of sight across both structures.

At this location, the northbound and southbound roadways are cut 10 feet to 25 feet below grade. To provide clearance above the roadway, this alternative would require embankment to be placed 15 feet high or more on both sides to blend the overpass structures into the surrounding terrain. A maximum slope rate of 5:1 would be used to provide a

desirable line of sight, minimize erosion, and blend with the existing terrain. This grading would be contained in ADOT right-of-way.

The slope design, structural aesthetics, and fencing layout would all consider potential visual impacts with the intent of minimizing the contrast between the structure and its surroundings.

Structures and fill areas would be visible in both northbound and southbound directions, disrupting distant views. The northbound structure would be more prominent. The improvements would not impact cultural sites.

The estimated cost for this overpass structure, including associated fencing, is \$7,100,000.

Based on this preliminary concept and evaluation, this location is not recommended as a wildlife passage for the following reasons:

- Two structures would be required, increasing visual impact and cost.
- Tall embankments would be required at the approaches to the northbound structure.
- This area experienced a low vehicle/wildlife crash rate.

3.4.3 Wide Median (SB) (MP 309.8)

This section describes a proposed wildlife overpass southbound at MP 309.8. This potential overpass, along with a proposed wildlife undercrossing northbound at MP 310.2 and fencing connecting the structures, could provide connectivity across I-17. The proposed northbound undercrossing is described in Section 3.3.3.

This location was identified as a good opportunity for a wildlife overcrossing structure since the mainline is in a cut section and an overpass could be positioned to connect the terrain on each side with minimal disturbance.

The proposed alternative at this location is a single-span bridge above the southbound roadway in the cut section near MP 309.8. The bridge would span 100 feet with vertical abutments. The bridge would provide a wildlife path 75 feet wide. The grading at each approach would blend in with the surrounding terrain within ADOT right-of-way, although a substantial amount of right-of-way is necessary to provide a wide fenced path through the median.

The structure would impact visual quality. The structure would be visible for only a short duration in the southbound direction, but may be more visible in the northbound direction.

The estimated cost for this overpass structure, including the complementary underpass at northbound MP 309.8 and associated fencing, is \$6,800,000.

3.4.4 Southbound Scenic Overlook (MP 311.7)

A wildlife overpass was evaluated at this location due to the presence of a high cut slope on the east side, minimal median width, and a benched area to the west. The high cut slope would reduce earthwork requirements and the minimal median width would result in a shorter structure length.



Photo 15. Cut slope near MP 311.7, looking east. Cedar Tank Canyon is a prominent feature in this area with several hundred feet of relief. The roadway follows the side of the canyon slope with reversing curvature and a narrow median. A concrete barrier separates the northbound and southbound roadways. Rock cuts exceeding 100 feet in height are present along the northbound lanes, and drop-offs exceed 200 feet measured to the base of the canyon from the southbound lanes. Guardrail is present along the outside of the southbound lanes.

The DCR recommends shifting the mainline approximately 400 feet to the east in this area for geometric improvements. The realigned mainline would consist of four northbound lanes and three southbound lanes with a narrow median and concrete barrier. A cut slope on the east side would be similar to the existing cut slope and could connect to a wildlife overcrossing structure.

The proposed alternative for a wildlife crossing structure concept is a two-span bridge over I-17 with a total length of 240 feet and width of 75 feet. The two-span bridge would use a center pier in the median and accommodate 2:1 abutment foreslopes.

The east approach would blend with the adjacent cut slope with minimal earthwork. Embankment placed 25 feet high or more would be required to gradually raise the level of the west approach to the overcrossing structure. To provide sight lines for wildlife, and to be consistent with the adjacent terrain, the embankment would extend from the structure for several hundred feet to the southwest at a maximum 5:1 slope rate.

This location would be visible from both northbound and southbound lanes and disrupt distant views. There would be no impact to cultural sites.

The estimated cost for this wildlife overcrossing structure, including associated fencing, is \$5,700,000. Although the DCR improvements require new right-of-way, this wildlife crossing structure alternative does require additional new right-of-way.

3.4.5 Rocky Park Meadow (MP 314.4)

Rocky Park is one of several locations with a water/meadow feature associated with elk activity. Crash data indicates that this location has experienced a moderately high rate of wildlife-vehicle collisions.



Photo 16. Rocky Park Meadow left of I-17, looking southbound.

I-17 closely follows the existing terrain near Rocky Park. The area was evaluated for a wildlife overcrossing structure since there are no large drainages that provide good opportunities for wildlife undercrossing structures.

The proposed alternative for a wildlife crossing structure at this location is a wildlife overpass at MP 314.4. A two-span bridge with tall vertical abutments would be 270 feet long to span both roadways and a wide median.

Embankment approximately 10-15 feet high on both sides of the structure would be required to blend the bridge into the surrounding terrain. These

slope rates would be designed using a 5:1 maximum slope to provide reasonable sight distance and minimize erosion.

This location would be visible from both northbound and southbound lanes and disrupt distant views. There would be no impact to cultural sites.

Approximately 0.5 acres of new right-of-way would be required for the fill slope on the west side. The estimated cost for this wildlife overcrossing structure and associated fencing is \$6,500,000.

3.4.6 Willard Springs Meadow (MP 327.4)

From MP 325 to MP 330 and beyond, I-17 runs generally along the bottom of a hill that ascends steadily to the west. The west side is flatter and Willard Springs meadow is a prominent open area between MP 327.8 and MP 328.6. This meadow is associated with elk activity.

The cut section south of the meadow at MP 327.4 was identified as a candidate location for a wildlife overpass. An overpass close to the meadow was proposed because there are no large drainages around the meadow to couple with a wildlife underpass. An overpass is also advantageous because it would provide better sight lines than a wildlife underpass.

The proposed wildlife structure is a 75-foot wide two-span overpass bridge with several feet of earthen fill on the deck. Slopes on each side would gradually transition into the surrounding terrain. The west approach would be elevated 10 feet or more, and a 5:1 maximum slope rate would be used to provide a reasonable line of sight.

The structure would be 265 feet long with 2:1 abutment foreslopes. With a center pier, the structure could be designed using AASHTO girders which allow for fast construction with minimal traffic delay.

As with all overpass concepts in this study, this structure would need to be designed to support several feet of earthen cover and would require tall fencing up to and across the structure. The new structure could present a restriction to oversized loads on I-17 below.

At this location fill slopes would blend into adjacent forested terrain; however, this location would disrupt northbound views of the San Francisco Peaks. There would be no impact to cultural sites.

Terrain modifications to the east would extend outside of ADOT right-of-way into CNF lands. Approximately 0.2 acres of new right-of-way is required with this alternative. The estimated cost for this wildlife overcrossing structure is \$5,500,000.

3.4.7 South of Kachina Village (MP 333.1)

This structure is the only overpass identified in the northernmost 12 miles of the project limits and represents a potential crossing between Kelly Canyon and Kachina Village. This segment of I-17 is depressed with steep cut slopes up to 30 feet high. An overpass structure within this area is proposed since it would have a good line of sight for animals and minimal grading requirements to blend in each approach.

This location would be visible from both northbound and southbound lanes and disrupt distant views, but only briefly. There would be no impact to cultural sites.

The proposed wildlife structure is a 75-foot wide overpass bridge at MP 333.1. A two-span girder bridge with 2:1 abutment foreslopes would be 280 feet long and would provide at least 16.5 feet of vertical clearance for I-17. No new right-of-way would be required with this concept. The estimated cost for this wildlife overcrossing structure is \$6,500,000. Because of its proximity to the potential wildlife crossing at Kelly Canyon (MP 332.3), only one of the two crossings is recommended; this location was preferred by the study team.

3.5 Shared-Use Traffic Interchanges

3.5.1 Introduction

Combining wildlife crossing needs with low-volume interchanges was conceived as a practical means to improve wildlife connectivity with an incremental cost increase over traditional transportation infrastructure. A shared-use wildlife/traffic interchange would be an interchange designed for wildlife and vehicles to occupy the same or adjacent paths across I-17.

The following locations were evaluated as potential shared-use wildlife/traffic crossings:

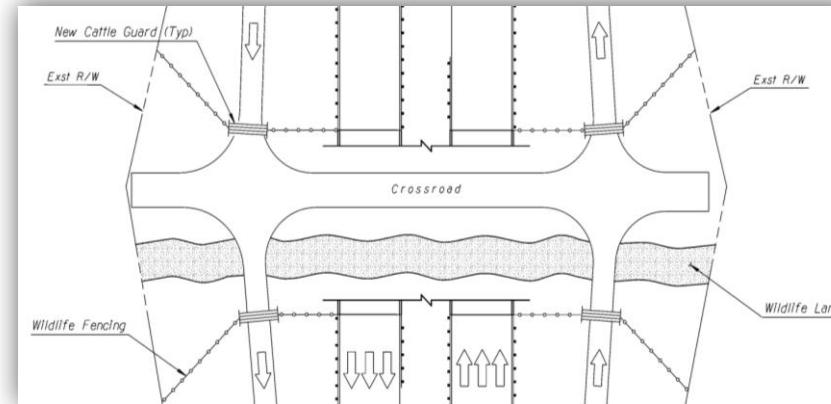
- Stoneman Lake TI (MP 306.3)
- Rocky Park TI (MP 315.6)
- Schnebly Hill Road TI (MP 320.5)
- Willard Springs TI (MP 326.2)
- Newman Park TI (MP 328.8)
- Kelly Canyon TI (MP 331.1)

The projected traffic volumes of these cross roads vary from 40 cars/day to 330 cars/day in a 2035 design year.

Dual-use underpass concepts include a “wildlife lane” or separate path outside of the paved roadway with a dirt surface that would be more attractive to large ungulates than the paved roadway surface. Wildlife

fencing would channel animals to the wildlife lane. At interchanges, this fencing would need to tie into cattle guards on the ramps. A schematic layout of this configuration is shown on Figure 2.

Figure 2 – Wildlife Lane



Double cattle guards – back to back for a longer crossing path – would help prevent elk movement along the ramps. However, double cattle guards can become ineffective during inclement weather if they become covered with ice, and they can cause other problems at the interface with roadway pavement (e.g. warped pavement that causes a bumpy ride). Electrified mats may be a solution, but their application would require further evaluation.

Double cattle guards at each ramp are included in the cost estimate of all shared-use interchange concepts as placeholder items. However, double cattle guards are unacceptable to Flagstaff District because of the difficulties associated with maintenance; other options/ technological solutions should be explored during final design.

Visual impacts associated with wildlife fencing at shared-use traffic interchanges may include the introduction of new lateral fences (e.g., fences along the crossroad).

The performance of shared-use interchanges should be evaluated and the results used to evaluate the utility and improve the effectiveness of future shared-use interchange conversions.

3.5.2 Stoneman Lake Road TI (MP 306.3)

The Stoneman Lake Road TI was initially considered for a shared-use wildlife/roadway grade separation.



Photo 17. Existing Stoneman Lake Road culvert under I-17.

The DCR recommends reconstruction of the TI, including new three-span bridges.

During alternative development, this location was eliminated from consideration as a shared-use wildlife crossing for the following reasons:

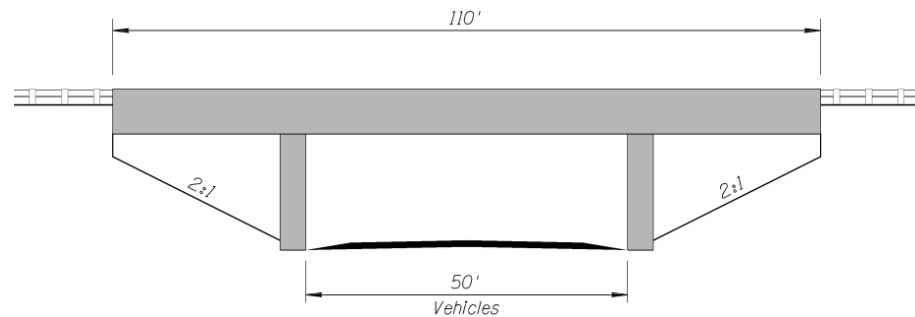
- The crash rate is very low in this area.
- Stoneman Lake Road is projected to carry 330 cars/day in 2035—the highest volume interchange identified for a shared-use wildlife/roadway crossing. The relatively high traffic volume could discourage wildlife from using the crossing.

3.5.3 Rocky Park TI (MP 315.6)

The existing Rocky Park TI structures are a pair of single-span concrete bridges with vertical abutments. The cross road opening is 25 feet wide and 15.5 feet tall.

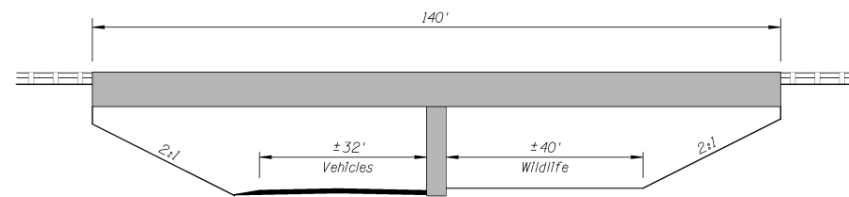
The DCR recommends that these bridges be replaced with new three-span bridges having center spans of 50 feet and abutment foreslopes of 2:1. The total length for each bridge would be 110 feet. The height would be a minimum of 16.5 feet above Rocky Park Road. The proposed three-span structure concept is illustrated on Figure 3:

Figure 3 – Three-Span Bridge



In order to provide a desirable shared-use wildlife/vehicle structure, two-span structures with lengths of 140 feet would be constructed instead of 110-foot-long three-span bridges. This structure would feature a center pier; the roadway would be located within one side of the structure with the opposite side designated as the wildlife lane with a natural substrate. Vegetation near the pier would be included to shield the vehicle lane from the wildlife lane. The two-span structure concept is shown on Figure 4.

Figure 4 – Two-Span Bridge with Wildlife Lane



Compared to a three-span bridge, the two-span bridge with wildlife lane requires 3,000 square feet of additional deck area and an increase in estimated cost of \$800,000.

The modifications would not impact visual quality or cultural sites.

The estimated cost for this shared-use structure, including associated fencing, is \$2,000,000.

3.5.4 Schnebly Hill Road TI (MP 320.5)

The suitability of this location as a shared-use crossing may be determined by monitoring the results of the current ADOT fencing project. Monitoring would begin when construction is complete.

The DCR recommends that the existing Schnebly Hill Road TI bridges be replaced with new three-span bridges with center spans of 50 feet and abutment foreslopes of 2:1. The structure lengths would be 110 feet. The vertical clearance would be a minimum of 16.5 feet above Schnebly Hill Road.



Photo 18. Schnebly Hill TI. The existing structures are single-span concrete bridges with vertical abutments. The cross road opening is 25 feet wide and 14 feet tall.

In order to provide a desirable dual use wildlife/vehicle structure, two-span structures with lengths of 140 feet would be constructed instead of three-span bridges. The structures would feature a center pier; the roadway would be located within one side of the structure with the opposite side designated as the wildlife lane with a natural substrate. Vegetation near the pier would be included to shield the vehicle lane from the wildlife lane.

The modifications would not impact visual quality or cultural sites.

The estimated cost for this shared-use structure, including associated fencing, is \$1,200,000.

3.5.5 Willard Springs TI (MP 326.2)

The Willard Springs TI was identified as a good candidate for a dual-use underpass. The existing bridges provide sloping sides rather than vertical abutment walls. The TI is well lit and open in nature. Fencing on both sides of I-17 is necessary for the dual-use aspect of this TI to function properly.

The DCR recommends that the existing bridges be widened in like kind. Along with bridge widening, reconstruction of Willard Springs Road is recommended to improve vertical clearance. The reconstruction would lower the cross road surface approximately two additional feet under the southbound structure.

The modifications would not impact visual quality or cultural sites.

Because of the openness of the existing structure, no improvements specific to wildlife are proposed. The estimated cost for the fencing and escape measures is \$1,300,000.

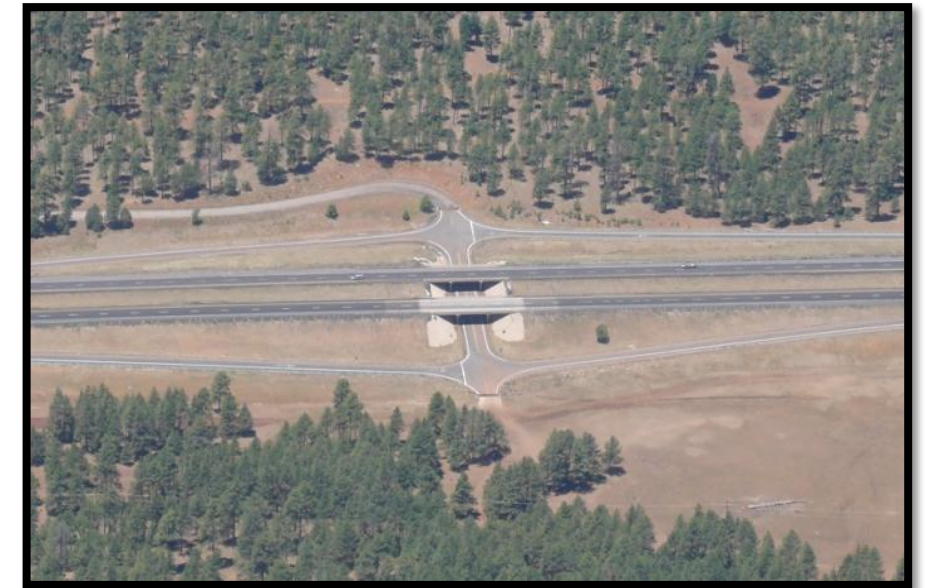


Photo 19. Willard Springs TI, looking west.

3.5.6 Newman Park TI (MP 328.8)

Newman Park is another location with a water/meadow feature associated with elk activity.

The existing structures are single-span concrete bridges with vertical abutments. The cross road opening is 25 feet wide and 14 feet tall.

The DCR recommends that these bridges be replaced with new three-span bridges with center spans of 50 feet and abutment foreslopes of 2:1. The total structure length for each bridge would be 110 feet. The height would be a minimum of 16.5 feet above Newman Park Road.

In order to provide a shared-use wildlife/vehicle structure, two-span structures with lengths of 140 feet would be constructed instead of 110-foot-long three-span bridges. The structures would have a center pier and the roadway would be located entirely within one side of the structure. The opposite side would be designated as the wildlife lane and would feature a natural substrate. Vegetation near the pier would be included to shield the vehicle lane from the wildlife lane.

The improvements would not impact visual quality or cultural sites.

The estimated cost for this shared-use structure, including associated fencing, is \$2,100,000.

3.5.7 Kelly Canyon TI (MP 331.1)

This location was evaluated as a candidate for a shared-use wildlife/traffic overcrossing structure but eliminated from further consideration during concept development. It represents the only dual-use wildlife overcrossing alternative considered with this project.

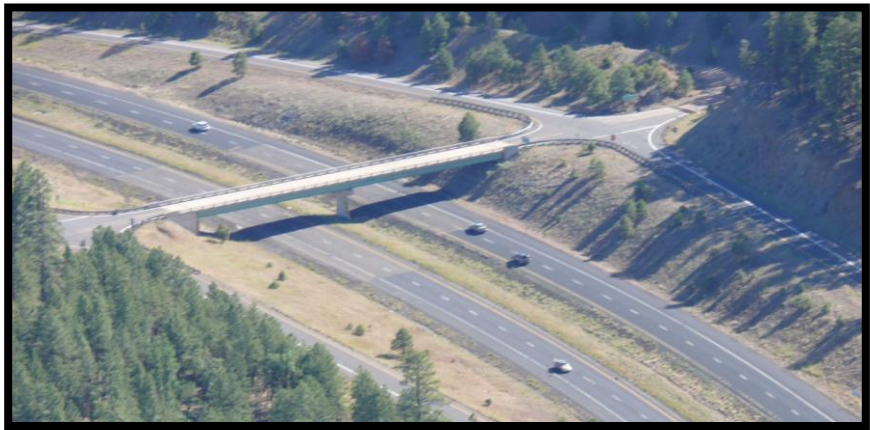


Photo 20. Kelly Canyon TI, looking southwest.

The existing Kelly Canyon TI structure is a two-span steel bridge that carries Kelly Canyon Road over I-17. The structure is 26 feet wide, 180 feet long, and has 1.5:1 abutment foreslopes. A wildlife crossing concept using the existing roadway bridge may not be successful because elk are not known to use long, narrow pathways like the existing bridge over I-17 and the presence of vehicles would likely discourage them from using the crossing.

A separate bridge exclusively for wildlife at this location would be less practical than a crossing located away from the interchange, where there is no vehicular traffic.

This location would have negligible impact to visual quality and would not impact cultural sites.

This location was eliminated from consideration as a wildlife crossing structure location for the following reasons:

- It is not practical to construct a shared-use structure when other locations without traffic that would likely have better chances for success are nearby.
- Other wildlife crossing structures are recommended at nearby MP 330.3 (0.8 miles south) and MP 332.3 (1.2 miles north).
- Tall and potentially solid fencing is desirable to keep animals on the bridge and unaware of the roadway below; this fencing would be a sight distance hazard to motorists and create a tunnel-like effect along the cross road.

3.6 Evaluation Matrix

The alternatives were screened for fatal flaws through an alternative comparison matrix. Table 2 contains the evaluation matrix of the preliminary wildlife crossing concepts.

Table 2 – Wildlife Connectivity Structure Evaluation Matrix


Existing Drainage/Structure				Drainage/Structure Needs Based on Roadway Engineering			Recommendations for Wildlife Crossings							
Potential Wildlife Crossing Number	Milepost	Approximate Station (Northbound)	Name/Location Characteristics	Size	Length	DCR Cost New / Extension	Proposed Structure	Comments	Recommended Location	Distance to Next Crossing (mile)	Additional Cost			Priority Tier
				Existing	Existing						New Right-of-Way	Wildlife fence, escape ramps, gates, cattle guard, old fence removal	Wildlife structure, removals, guard rail, earthwork, retaining wall, landscaping.	
				Proposed	Ultimate									
1	306.3	5581+00	Stoneman Lake Road TI	25'x13' Box 3-span 110' (NB) 3-span 110' (SB)	130' (Incl. 50' Open Median) 185' (Incl. 50' Open Median)	\$4,700,000	Shared-Use TI Replace with 2-span bridge; road on one side of center pier and wildlife lane on other	After initially being identified as a potential wildlife crossing location, this site was eliminated from further consideration at the second field review 4-23-09 by AGFD due to the low strike data and unsuitability of the medium-volume interchange to handle elk passage.	No	-	None	-	Not calculated.	N/A
2A	307.0	5620+00	South of Rattlesnake Canyon	N/A	N/A	None	Overcrossing New Landscaped Bridge Width = 75' Length = 112' (NB) 100' (SB)	Clearance restriction for over-sized loads. Structures and fill areas would be visible in the NB and SB direction, disrupting distant views. NB would be more prominent. No cultural sites.	No	-	None	\$1,500,000	\$5,600,000	N/A
				N/A	N/A							Total = \$7,100,000		
2B	SB 307.1 NB 307.4	SB 5625+00 NB 5638+00	Rattlesnake Canyon	2-12' Pipes	226' (NB) 274' (SB)	\$400,000	Undercrossing New arch culverts above drainage floor Width = 48' Height = 12' Length = 205' (NB) 180' (SB)	Large box culverts would be placed in the existing fill section, above the 12-foot pipes and away from the 10x10-foot box culverts. Bifurcated alignments and sloping terrain add to difficulty of construction. Potential to impact nearby archaeological site. No visual impact or cultural sites.	No	-	None	\$1,500,000	\$9,000,000	N/A
				2-12' Pipes	301' (NB) 299' (SB)							Total = \$10,500,000		
2C	SB 307.2 NB 307.4	SB 5629+00 NB 5639+00	Rattlesnake Canyon	2-10'x10' Boxes	143' (NB) 63' (SB)	\$400,000	Undercrossing New single-span bridges above drainage floor Width = 40' Height = 12' Length = 75' (NB) 63' (SB)	Single-span bridges would replace the 10x10-foot box culverts. Bifurcated alignments and sloping terrain add to difficulty of construction. Potential to impact nearby archaeological site. No visual impact or cultural sites.		-	None	\$1,500,000	\$4,900,000	2
				2-10'x10' Boxes	188' (NB) 109' (SB)							Total = \$6,400,000		

Table 2 – Wildlife Connectivity Structure Evaluation Matrix (Continued)





Existing Drainage/Structure				Drainage/Structure Needs Based on Roadway Engineering			Recommendations for Wildlife Crossings								
Potential Wildlife Crossing Number	Milepost	Approximate Station (Northbound)	Name/Location Characteristics	Size	Length	DCR Cost New / Extension	Proposed Structure	Comments	Recommended Location	Distance to Next Crossing (mile)	Additional Cost			Priority Tier	
				Existing	Existing						New Right-of-Way	Wildlife fence, escape ramps, gates, cattle guard, old fence removal	Wildlife structure, removals, guard rail, earthwork, retaining wall, landscaping.		
				Proposed	Ultimate										
3	SB 309.8	5766+00	Wide Median	N/A	N/A	None	Overcrossing New Landscaped Bridge Width = 75’ Length = 100’	Clearance restriction for over-sized loads. Structure would be visible for only a short duration from the SB direction, may be more visible from NB direction.		1.7	53 acres (R/W needs will depend on width of fenced path through median)	\$1,500,000	\$1,900,000	3	
3	NB 310.2	5785+00	Wide Median	24” Pipe	125’	None	Undercrossing New arch culvert Width = 48’ Height = 12’ Length = 120’						\$3,400,000		
				24” Pipe	140’							Total = \$6,800,000			
4	311.7	5868+00	Scenic Overlook	None	None	None	Overcrossing New Landscaped Bridge Width = 75’ Length = 240’	Blends into cut slope to the east, requires embankment fill to the west. Clearance restriction for over-sized loads. Structure and fill would be visible from NB and SB lanes and disrupt distant views. No cultural sites.		2.7	None	\$1,300,000	\$4,300,000	2	
				N/A	N/A										Total = \$5,700,000
5	314.4	6010+00	Rocky Park Meadow	None	None	None	Overcrossing New Landscaped Bridge Width = 75’ Length = 270’	Partially fits into terrain; would require embankment fills up to 20 feet. Clearance restriction for over-sized loads. Structure and fill would be visible from NB and SB lanes and disrupt distant views. No cultural sites.		1.2	0.5 acres	\$1,200,000	\$5,300,000	1	
				N/A	N/A										Total = \$6,500,000
6	315.6	6071+00	Rocky Park TI	25’x15’ Box	130’ (Incl. 50’ Open Median)	\$4,300,000	Shared-Use TI Replace with 2-span bridge; road on one side of center pier and wildlife lane on other	Shared-use TI concept used with low-volume cross road. Dual cattle guards required on ramps. No visual impact or impact to cultural sites.		1.4	None	\$1,200,000	\$800,000	1	
				3-span 110’ (NB) 3-span 110’ (SB)	150’ (Incl. 25’ Open Median)							Total = \$2,000,000			

Table 2 – Wildlife Connectivity Structure Evaluation Matrix (Continued)



Existing Drainage/Structure				Drainage/Structure Needs Based on Roadway Engineering			Recommendations for Wildlife Crossings							
Potential Wildlife Crossing Number	Milepost	Approximate Station (Northbound)	Name/Location Characteristics	Size	Length	DCR Cost New / Extension	Proposed Structure	Comments	Recommended Location	Distance to Next Crossing (mile)	Additional Cost			Priority Tier
				Existing	Existing						New Right-of-Way	Wildlife fence, escape ramps, gates, cattle guard, old fence removal	Wildlife structure, removals, guard rail, earthwork, retaining wall, landscaping.	
				Proposed	Ultimate									
7	317.0	6160+00	Woods Canyon	3-span 178' (NB) 3-span 186' (SB)	130' (Incl. 50' Open Median)	\$5,200,000	Undercrossing per DCR	Reconstruct NB bridge; widen SB bridge. No change to wildlife path.		2.2	Included in DCR	\$500,000	None	No Substantial Change to Existing Structure
				3-span 190' (NB) 3-span 186' (SB)	150' (Incl. 25' Open Median)							Total = \$500,000		
8A	319.2	6276+50	Skeleton Park	8'x9' Box	169'	\$200,000	Undercrossing Replace with arch culvert Width = 48' Height = 12' Length = 210'	Mainline profile would need to be raised approximately 8 feet to accommodate larger culvert. No visual impact or impact to cultural sites.	No	1.3	None	\$100,000	\$4,800,000	N/A
												Total = \$4,900,000		
8B											8'x9' Box + 78" Pipe	215'		Undercrossing Replace with single-span bridges Width = 40' Height = 12' Length = 63' (NB) 63' (SB)
								Total = \$4,400,000						
9	320.5	6344+00	Schnebly Hill Road TI	25'x14' Box	130' (Incl. 50' Open Median)	\$4,300,000	Shared-Use TI Replace with 2-span bridges; road on one side of center pier and wildlife lane on other	Shared-use TI concept used with low-volume cross road. Dual cattle guards required on ramps. No visual impact or impact to cultural sites.		1.5	None	\$400,000	\$800,000	3
				3-span 110' (NB) 3-span 110' (SB)	150' (Incl. 25' Open Median)							Total = \$1,200,000		

Table 2 – Wildlife Connectivity Structure Evaluation Matrix (Continued)




Existing Drainage/Structure				Drainage/Structure Needs Based on Roadway Engineering			Recommendations for Wildlife Crossings								
Potential Wildlife Crossing Number	Milepost	Approximate Station (Northbound)	Name/Location Characteristics	Size	Length	DCR Cost New / Extension	Proposed Structure	Comments	Recommended Location	Distance to Next Crossing (mile)	Additional Cost			Priority Tier	
				Existing	Existing						New Right-of-Way	Wildlife fence, escape ramps, gates, cattle guard, old fence removal	Wildlife structure, removals, guard rail, earthwork, retaining wall, landscaping.		
				Proposed	Ultimate										
10	322.0	6425+00	Munds Canyon	3-span 383' (NB) 3-span 323' (SB)	190' (Incl. 100' Open Median)	\$4,900,000	Undercrossing Fence to Existing Bridge	No visual impact or impact to cultural sites. Minimal Section 404 impact.		2.4	None	\$500,000	None	No Substantial Change to Existing Structure	
				3-span 383' (NB) 3-span 323' (SB)	220' (Incl. 75' Open Median)							Total = \$500,000			
11	323.4	6498+00	Munds Wash	2-10'x10' Box	212'	\$1,000,000	Undercrossing Replace existing structure with concrete arch culvert. Span = 48' Rise = 12' Length = 210'	Crossing sited in developed area; AGFD would prefer another location but could accept this one if a better location is not identified. Mainline profile would need to be raised approximately 5 feet to accommodate crossing structure. Shared drainage culvert. No visual impact or cultural sites. Section 404 impacts are anticipated.	No	-	None	Since this location was not recommended, the cost for fencing was assigned to adjacent recommended locations.	\$4,600,000	N/A	
				2-10'x10' Box + 3-10'x8' Box	255'							Total = \$4,600,000 (Does not include fencing)			
12	324.4	6548+00	Munds Ranch Road	15'x15' Box	178'	\$2,900,000	Undercrossing Match DCR Dimensions	AGFD preferred this location over Munds Wash. No visual impact or impact to cultural sites.		1.9	None	\$1,700,000	None	1	
				1-span Bridges NB & SB 22' x 14.5'	175' (Incl. 50' Open Median)							Total = \$1,700,000			
13	326.3	6646+00	Willard Springs TI	3-span 107'	130' (Incl. 50' Open Median)	\$1,300,000	Shared-Use TI	Existing structure to be widened, resulting in shared-use TI with wildlife and traffic sharing the existing roadway. Double cattle guards required on ramps. No visual impact or impact to cultural sites.		1.1	None	\$1,300,000	None	No Substantial Change to Existing Structure	
				3-span 107'	63' (NB) 63' (SB)							Total = \$1,300,000			

Table 2 – Wildlife Connectivity Structure Evaluation Matrix (Continued)



Existing Drainage/Structure				Drainage/Structure Needs Based on Roadway Engineering			Recommendations for Wildlife Crossings							
Potential Wildlife Crossing Number	Milepost	Approximate Station (Northbound)	Name/Location Characteristics	Size	Length	DCR Cost New / Extension	Proposed Structure	Comments	Recommended Location	Distance to Next Crossing (mile)	Additional Cost			Priority Tier
				Existing	Existing						New Right-of-Way	Wildlife fence, escape ramps, gates, cattle guard, old fence removal	Wildlife structure, removals, guard rail, earthwork, retaining wall, landscaping.	
				Proposed	Ultimate									
17	331.1	6904+00	Kelly Canyon TI	Two-span 26'	180'	None	Shared-Use TI Width = 26' Length = 180'	This location would require that wildlife and vehicles share a narrow bridge or add a new structure parallel to the road structure. Placement of a wildlife overcrossing structure inside a TI is undesirable due to large cost associated with structure elements that could otherwise be located away from traffic. Negligible visual impact. No cultural sites.	No	-	None	Since this location was not recommended, the cost for fencing was assigned to adjacent recommended locations.	\$4,900,000	N/A
				2-span 26'	180'							Total = \$4,900,000 (Does not include fencing)		
18	332.3	6967+50	Kelly Canyon Culvert	84" Pipe	266'	\$200,000	Undercrossing Replace culvert with single-span bridges Width = 10' Height = 15' Length = 63' (NB) 63' (SB)	New bridges would replace the existing drainage culvert and serve dual purpose. Wildlife bench in abutment foreslope. No visual impact or impact to cultural sites.	Due to close proximity, only one of these is recommended.	-	None	\$1,600,000	\$3,800,000	N/A
				84" Pipe + 78" Plpe	310'							Total = \$5,400,000		
19	333.1	7010+00	South of Kachina Village	None	None	None	Overcrossing New Landscaped Bridge Width = 75' Length = 280'	Overcrossing fits well into existing terrain, requiring minimal terrain modifications at each end. Clearance restriction for over-sized loads. Structure would be visible for short distances from each travel direction, compared to other overcrossings. Approach slope visibility would be minimal. No impact to cultural sites.			None	\$1,600,000 (repeat of #18)	\$4,900,000	2
				N/A	N/A							Total = \$6,500,000		

Table 2 – Wildlife Connectivity Structure Evaluation Matrix (Continued)

Existing Drainage/Structure				Drainage/Structure Needs Based on Roadway Engineering			Recommendations for Wildlife Crossings							
Potential Wildlife Crossing Number	Milepost	Approximate Station (Northbound)	Name/Location Characteristics	Size	Length	DCR Cost New / Extension	Proposed Structure	Comments	Recommended Location	Distance to Next Crossing (mile)	Additional Cost			Priority Tier
				Existing	Existing						New Right-of-Way	Wildlife fence, escape ramps, gates, cattle guard, old fence removal	Wildlife structure, removals, guard rail, earthwork, retaining wall, landscaping.	
20	334.3	7072+50	Pumphouse Wash	3-10'x8' Box	200'	\$800,000	N/A	After initially being identified as a potential wildlife crossing location, this site was eliminated from further consideration at the second field review 4-23-09 by AGFD due to the existing and ongoing developments in the area that are anticipated to reduce the suitability of the area as elk habitat.	No	-	None	-	None	N/A
				3-10'x12' Box + 3-10'x10' Box	220'									
21	336.1	7165+00	Old Munds Highway	15'x15' Box	178'	\$3,100,000	Undercrossing Match DCR dimensions	Coconino County requested replacement of the existing 15x15-foot box culvert to provide two lanes of traffic on Old Munds Highway. No visual impact.		-	None	\$2,100,000	None	3
				1-span Bridges NB & SB 30' x 14.5'	175' (Incl. 50' Open Median)							Total = \$2,100,000		

Notes: Length = distance that wildlife is required to travel to cross the roadway.
Wildlife fencing elements and unit costs are as follows: game fence=\$20/linear foot; jumpouts/escape ramps=\$15,000/each (1 every 0.5 mile plus 4 at each crossing); access gate=\$4,000 (1 every mile of game fence); dual cattle guards at TI ramps.
The cost for each segment of wildlife fencing, including escape measures, was assigned to each wildlife crossing structure cost estimate based on a prorated length from the midpoint to the previous and following structures.

3.7 Preliminary Recommendation

Of the locations identified for wildlife connectivity structures, 16 are recommended for inclusion as part of the I-17 improvements. Figure 5 on pages 21-23 reflects the preliminary recommendations for wildlife crossings.

4.0 Implementation

4.1 Introduction

This feasibility evaluation was prepared under the premise that potential wildlife crossing structures would be constructed with the Preferred Alternative. Accordingly, the implementation strategy of the roadway improvements would likely be the basis for the implementation of the wildlife crossing structures.

Funding availability is unknown for all wildlife crossing structures.

This report does not constitute a commitment that ADOT will construct any of the recommended wildlife crossing structures; rather, it is intended to make preliminary recommendations and provide ADOT, FHWA, CNF, AFGD, and others technical information on the engineering, environmental, cost, and right-of-way impacts of potential wildlife crossing structures. This report does not address the feasibility of wildlife crossing structures as standalone projects.

4.2 Monitoring

Monitoring usage of wildlife crossing structures provides biologists and engineers with information to evaluate their effectiveness and improve future designs. Monitoring can occur directly through visual observation or indirectly through data collection and interpretation. Indirect monitoring methods include studying elk movement using GPS collar data or evaluating post-construction wildlife-vehicle crash statistics.

Visual monitoring could consist of video surveillance cameras at each wildlife crossing structure integrated with sensors that trigger recording when an animal approaches a structure. Cameras could also be used

when wildlife are not present to identify obstructed paths or use by off-highway vehicles. Since power is unavailable at most locations, camera systems would likely require isolated solar power stations.

A wildlife monitoring plan should be included with the wildlife crossing structures in this project. The details of the plan should be developed in conjunction with the final design of each wildlife structure to incorporate the latest available lessons learned from other monitoring plans.

4.3 Implementation Priorities

The following list is a preliminary summary of the recommended wildlife crossing priorities, although priorities will likely be set by I-17 project implementation and funding availability.

Tier 1 Priorities

These structures are considered the highest priority for implementation. Their locations represent areas with high wildlife-vehicle crash rates or greatest support by the project team. Tier 1 priorities include the following locations:

- Rocky Park Meadow (MP 314.2)
- Rocky Park TI (MP 315.6)
- Skeleton Park (MP 319.2)
- Munds Ranch Road (MP 324.4)
- Willard Springs Meadow (MP 327.4)

Tier 2 Priorities

These structures are considered a medium priority for implementation. Their locations represent areas with moderate wildlife-vehicle crash rates or moderate support by the project team. Tier 2 includes the following locations:

- Rattlesnake Canyon (MP 307.0)
- Southbound Scenic Overlook (MP 311.7)
- Newman Park TI (MP 328.8)
- James Canyon Culvert (MP 330.3)
- South of Kachina Village (MP 333.3)

Tier 3 Priorities

These structures are considered the lowest priority for implementation. Their locations represent areas with relatively low wildlife-vehicle crash rates. Tier 3 includes the following locations:

- Wide Median (SB MP 309.8, NB MP 310.2)
- Schnebly Hill Road TI (MP 320.5)
- Old Munds Highway (MP 336.1)

No Substantial Changes to Existing Structures

These structures already serve as wildlife crossings and will be retained.

- Woods Canyon Bridge (MP 317.0)
- Munds Canyon Bridge (MP 322.0)
- Willard Springs TI (MP 326.2)

5.0 Conclusion

The alternatives for wildlife crossing structures presented in this report are conceptual in nature. This document is intended to provide an initial evaluation of the feasibility of incorporating wildlife crossing structures into the I-17, Jct. SR 179 to I-40, Preferred Alternative as a means to reduce the number of wildlife-vehicle crashes and improve wildlife connectivity.

This report is intended to make preliminary recommendations and provide ADOT, FHWA, CNF, AFGD, and others technical information on the engineering, environmental, cost, and right-of-way impacts of potential wildlife crossing structures.

Ongoing industry research may provide important information on wildlife movements and crashes that can be used during final design to further evaluate final structure locations and types.

A Wildlife Technical Advisory Committee (WTAC), including representatives of ADOT, FHWA, AGFD, and USFS and other stakeholders, should guide the final design of wildlife crossing structures on I-17. The recommendations herein are intended to be adaptable to potential changes in mitigation techniques and means while preserving ADOT's commitment to the WTAC goals and objectives. The WTAC should update these initial concepts as appropriate to optimize their predicted effectiveness and share up-to-date comprehensive design guidance to improve the likelihood that a structure will be successful.

The analysis should be updated based on future conditions. Locations that were eliminated in this study may be reconsidered if conditions become more favorable. The locations studied in this document may not be the only candidates for wildlife crossing structures.

Figure 5 – Preliminary Recommended Wildlife Crossing Locations (1 of 3)

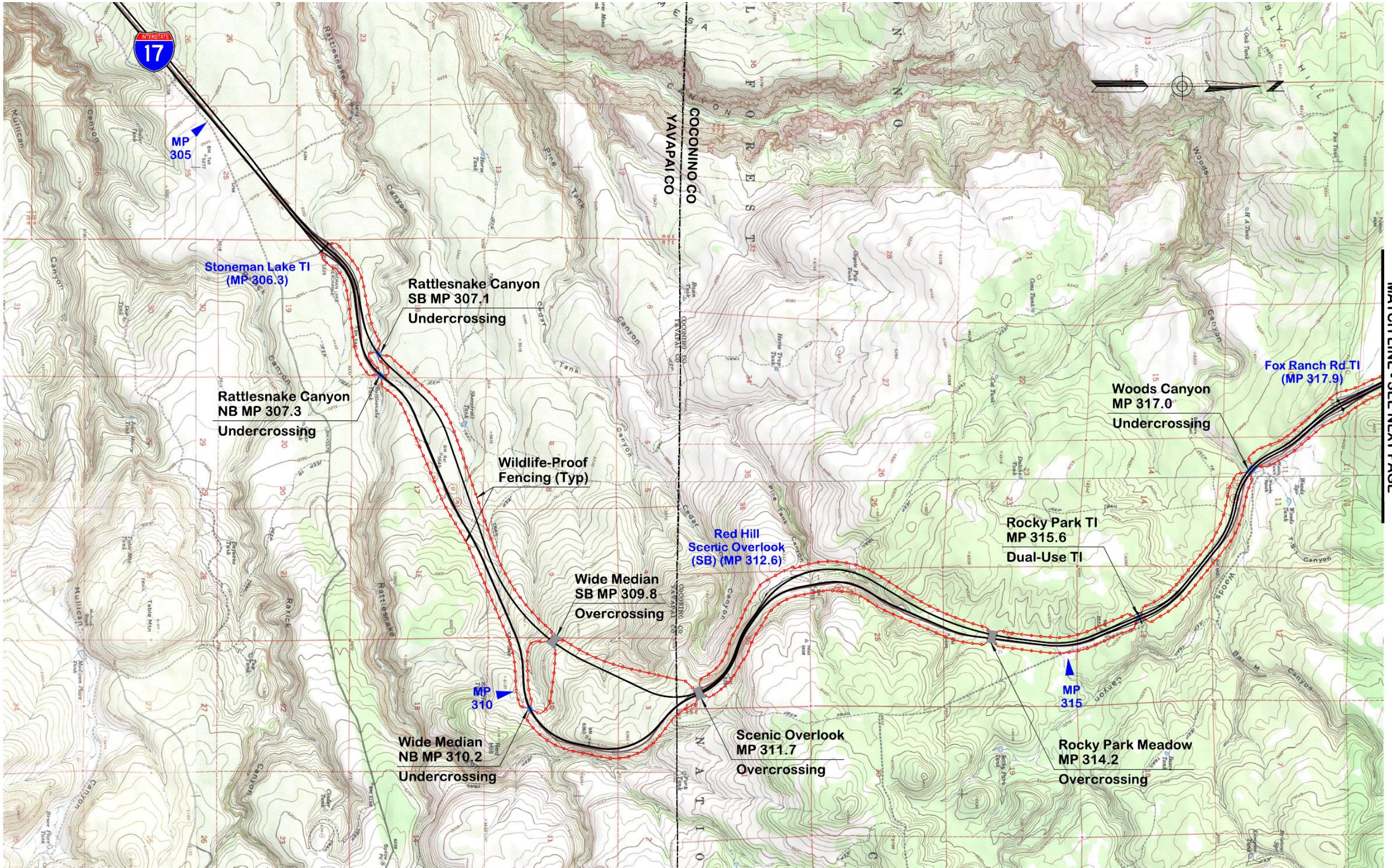


Figure 5 – Preliminary Recommended Wildlife Crossing Locations (2 of 3)

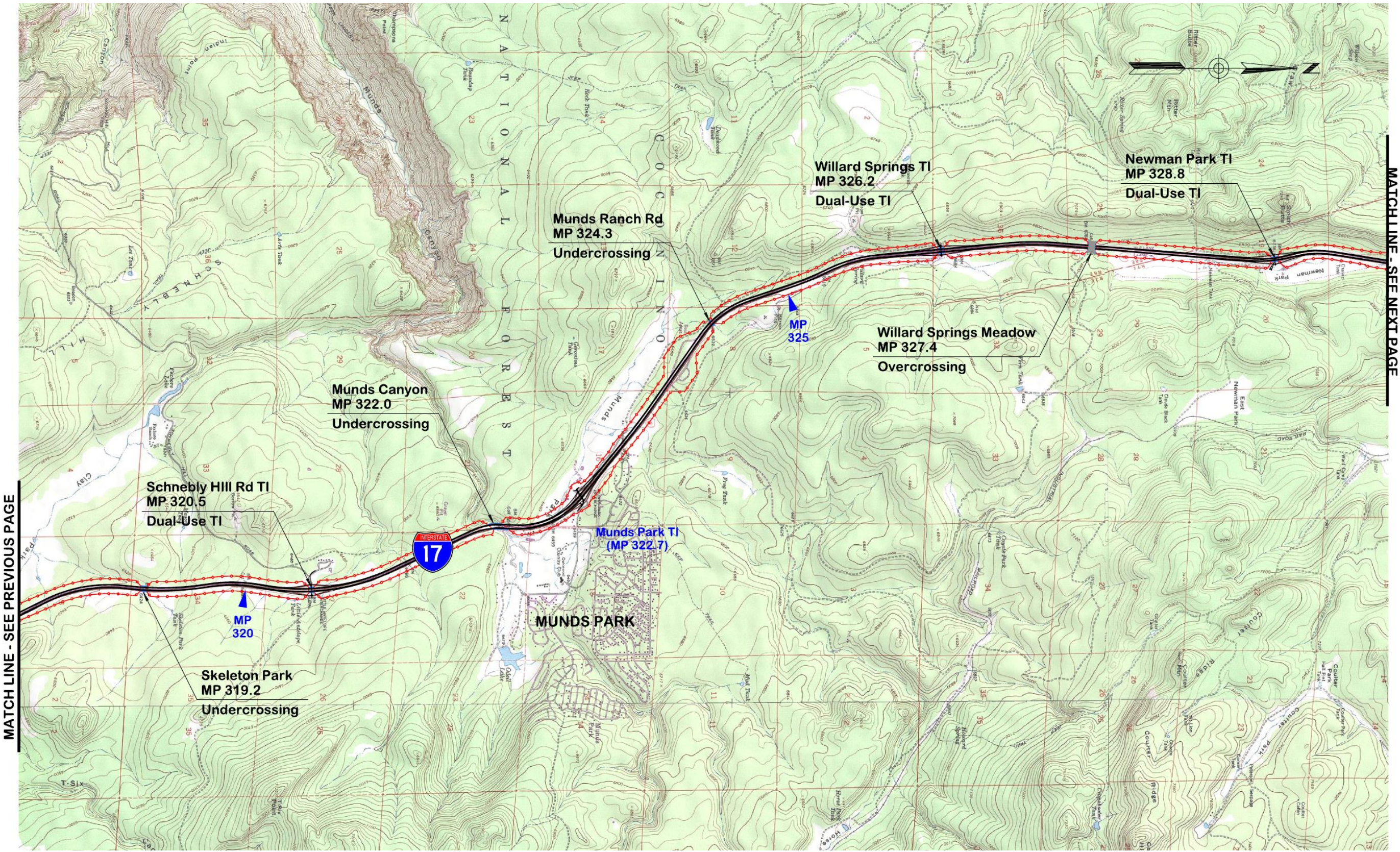
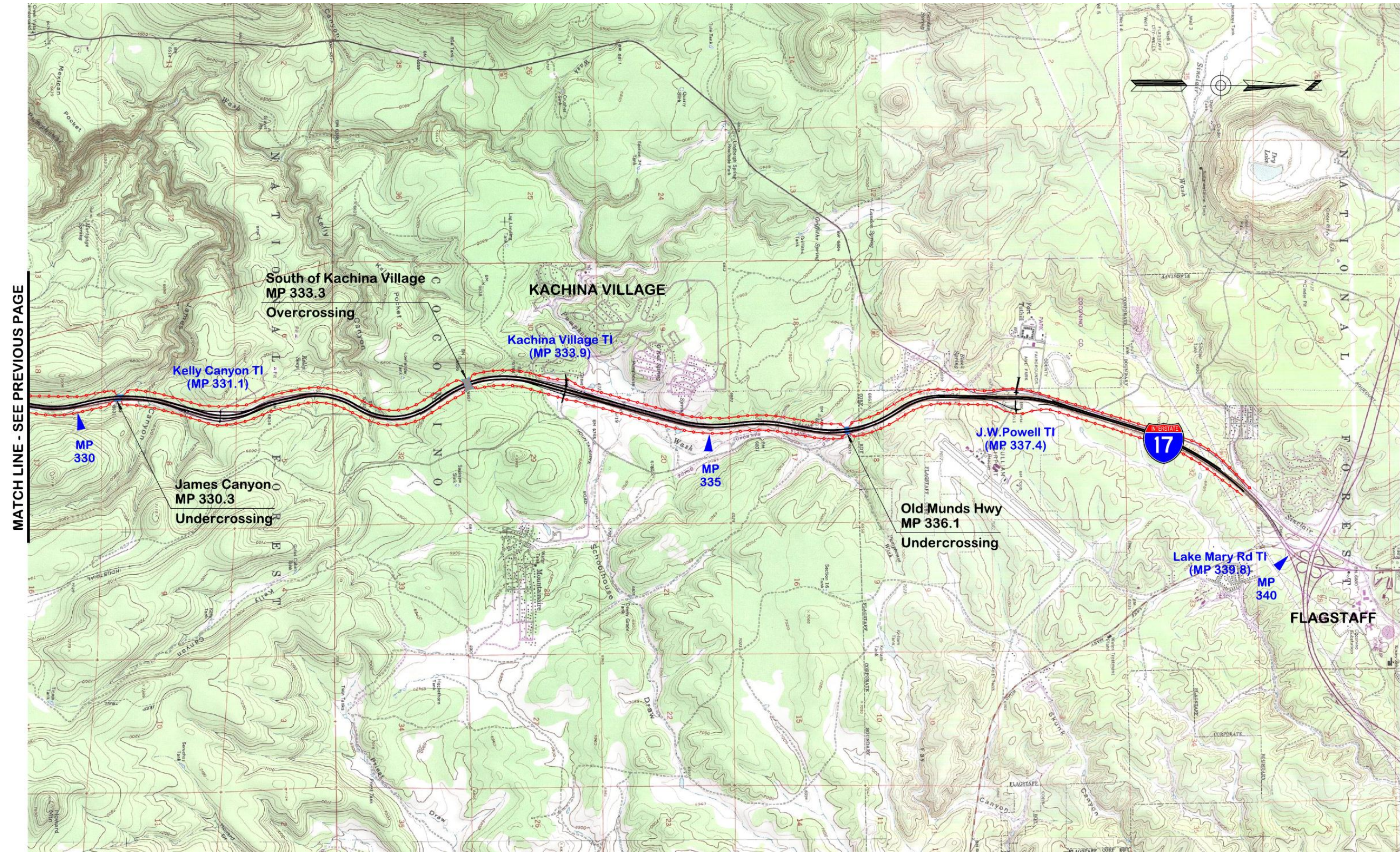


Figure 5 – Preliminary Recommended Wildlife Crossing Locations (3 of 3)



APPENDIX W1
WILDLIFE CRASH DATA

- 1. ADOT Crash Data (2001-2006)**
- 2. AGFD Crash Data (1989-2003)**

ADOT Crash Data

Wildlife Crashes

Crashes involving wildlife have been identified by ADOT as an area of concern within the study section. Therefore crashes with Wild Animal/Game were sorted and grouped for more detailed analysis in the Preliminary Traffic Report (2007) prepared for the IDCR. The data spanned a period from March 2001 to February 2006.

The ADOT Statewide Crash Database does not contain information regarding type of animal; therefore, the database may include crashes involving javelina, turkey, or other small game, in addition to deer or elk. Additionally, not all animal/vehicle crashes are reported and therefore would not be recorded in the Statewide Crash Database. The ADOT Northern Region Traffic Engineering office maintains a separate database which tracks dead animals found along the side of the road. This database contains information regarding type of animal. No attempt was made to compare or reconcile the two databases as part of the analysis presented herein.

Table A1 shows the severity of crashes with Wildlife/Game. Approximately 79% of crashes with wildlife in the northbound direction did not result in injury to the motorist. Approximately 80% of crashes with wildlife in the southbound direction are No Injury type crashes. There were no fatalities associated with crashes with wildlife within the study section during the five-year evaluation period.

Table A1 – Number of Wild Animal Crashes by Severity

WILD ANIMAL/GAME CRASHES-BY SEVERITY	MAR-01 TO FEB-02	MAR-02 TO FEB-03	MAR-03 TO FEB-04	MAR-04 TO FEB-05	MAR-05 TO FEB-06	YEARLY AVG	YEARLY AVG PERCENT
Northbound							
Fatal	0	0	0	0	0	0.0	0.00
Incapacitating Injury	0	0	0	0	0	0.0	0.00
Non-Incapacitating Injury	8	6	2	6	3	5.0	14.20
Possible Injury	3	5	2	0	0	2.0	5.68
No Injury	38	52	17	19	14	28.0	79.55
Unknown	0	0	0	1	0	0.2	0.57
Northbound Total	49	63	21	26	17	35.2	100%
Southbound							
Fatal	0	0	0	0	0	0.0	0.00
Incapacitating Injury	0	1	0	0	0	0.2	0.59
Non-Incapacitating Injury	2	4	3	6	1	3.2	9.41
Possible Injury	2	7	2	2	1	2.8	8.24
No injury	32	53	20	21	11	27.4	80.59
Unknown	0	1	0	0	1	0.4	1.18
Southbound Total	36	66	25	29	14	34.0	100%

Table A2 shows the number of crashes with Wild Animal/Game aggregated per mile for the study section. Approximately 51% of the Wild Animal/Game crashes occurred in the northbound direction and 49% occurred in the southbound direction.

Table A2 – Number of Wild Animal Crashes by Milepost

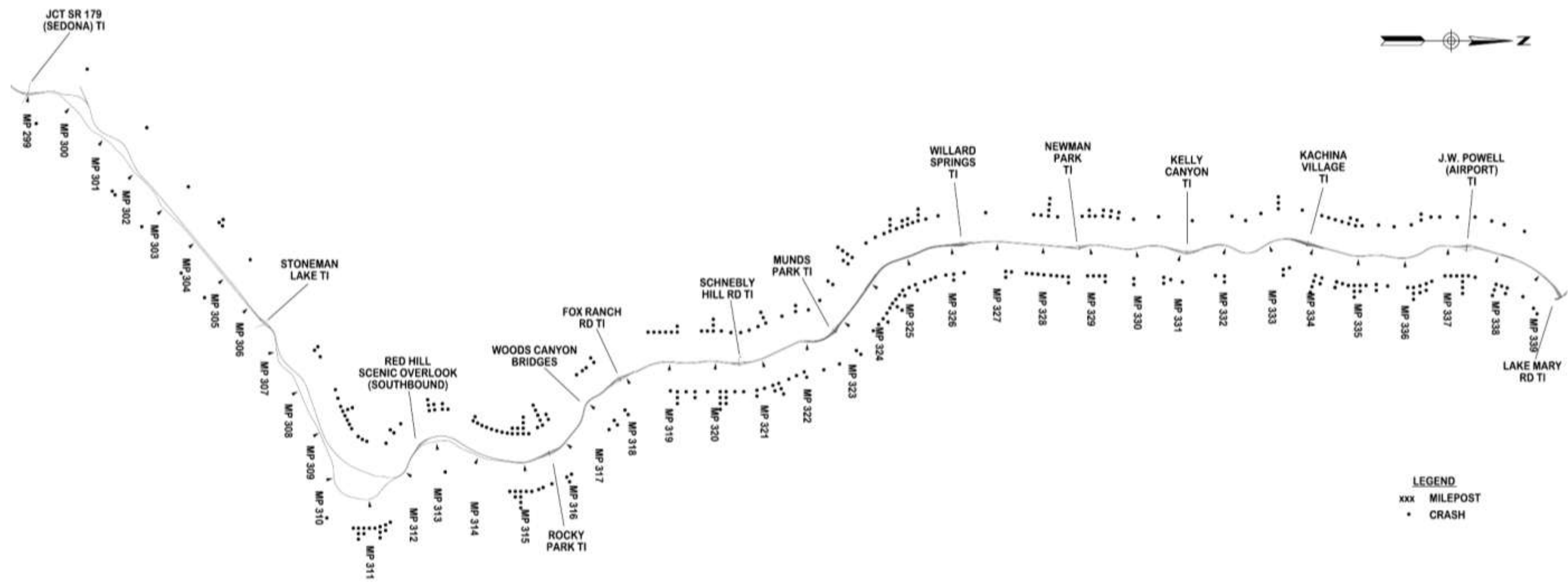
WILD ANIMAL/GAME CRASHES-BY MILEPOST	MAR-01 TO FEB-02	MAR-02 TO FEB-03	MAR-03 TO FEB-04	MAR-04 TO FEB-05	MAR-05 TO FEB-06	YEARLY AVG	YEARLY AVG PERCENT
Northbound							
299	0	1	0	0	0	0.2	0.57
300	0	0	0	1	0	0.2	0.57
301	0	0	0	0	0	0	0.00
302	1	0	0	1	0	0.4	1.14
303	0	0	0	1	0	0.2	0.57
304	0	0	1	0	0	0.2	0.57
305	1	0	0	0	0	0.2	0.57
306	0	0	0	0	0	0	0.00
307	0	0	0	0	0	0	0.00
308	0	0	0	0	0	0	0.00
309	0	0	0	0	0	0	0.00
310	0	1	1	0	0	0.4	1.14
311	6	2	2	1	1	2.4	6.82
312	0	0	0	1	0	0.2	0.57
313	1	0	0	0	0	0.2	0.57
314	0	0	0	2	1	0.6	1.70
315	5	2	1	1	0	1.8	5.11
316	1	2	1	0	0	0.8	2.27
317	0	1	1	1	1	0.8	2.27
318	1	0	0	0	0	0.2	0.57
319	0	4	2	0	1	1.4	3.98
320	4	3	1	1	4	2.6	7.39
321	1	4	0	4	2	2.2	6.25
322	2	3	1	1	0	1.4	3.98
323	2	6	0	0	0	1.6	4.55
324	2	3	0	2	0	1.4	3.98
325	0	0	1	1	1	0.6	1.70
326	0	1	0	0	0	0.2	0.57

WILD ANIMAL/GAME CRASHES-BY MILEPOST	MAR-01 TO FEB-02	MAR-02 TO FEB-03	MAR-03 TO FEB-04	MAR-04 TO FEB-05	MAR-05 TO FEB-06	YEARLY AVG	YEARLY AVG PERCENT
327	3	1	0	1	2	1.4	3.98
328	1	3	0	0	1	1	2.84
329	3	0	1	1	0	1	2.84
330	1	2	1	1	0	1	2.84
331	2	1	0	1	0	0.8	2.27
332	0	0	0	0	0	0	0.00
333	1	1	1	0	0	0.6	1.70
334	3	7	1	3	1	3	8.52
335	1	3	0	1	0	1	2.84
336	2	4	4	0	1	2.2	6.25
337	2	4	0	0	0	1.2	3.41
338	3	2	1	0	1	1.4	3.98
339	0	2	0	0	0	0.4	1.14
340	0	0	0	0	0	0	0.00
Northbound Total	49	63	21	26	17	35.2	100%
Southbound							
299	0	0	0	0	0	0	0.00
300	0	0	0	0	1	0.2	0.59
301	0	1	0	0	0	0.2	0.59
302	0	0	0	0	0	0	0.00
303	0	3	0	0	0	0.6	1.76
304	0	1	0	0	0	0.2	0.59
305	0	0	1	0	0	0.2	0.59
306	0	0	0	0	0	0	0.00
307	0	1	1	0	0	0.4	1.18
308	0	0	0	0	0	0	0.00
309	1	0	0	1	1	0.6	1.76
310	1	4	1	0	1	1.4	4.12
311	0	1	1	1	0	0.6	1.76
312	6	1	0	1	0	1.6	4.71
313	4	1	1	0	0	1.2	3.53
314	2	6	2	1	1	2.4	7.06

WILD ANIMAL/GAME CRASHES-BY MILEPOST	MAR-01 TO FEB-02	MAR-02 TO FEB-03	MAR-03 TO FEB-04	MAR-04 TO FEB-05	MAR-05 TO FEB-06	YEARLY AVG	YEARLY AVG PERCENT
315	0	1	3	2	0	1.2	3.53
316	1	0	1	4	1	1.4	4.12
317	3	3	0	2	1	1.8	5.29
318	1	2	0	2	0	1	2.94
319	0	3	1	0	0	0.8	2.35
320	2	5	0	0	1	1.6	4.71
321	3	2	1	0	1	1.4	4.12
322	0	2	0	1	0	0.6	1.76
323	2	5	1	0	0	1.6	4.71
324	1	8	0	3	1	2.6	7.65
325	1	1	0	0	0	0.4	1.18
326	0	0	0	1	0	0.2	0.59
327	1	1	1	0	0	0.6	1.76
328	1	0	2	3	0	1.2	3.53
329	2	1	2	1	3	1.8	5.29
330	0	0	0	2	0	0.4	1.18
331	1	0	0	0	0	0.2	0.59
332	0	2	1	0	0	0.6	1.76
333	0	2	1	0	1	0.8	2.35
334	1	2	3	2	0	1.6	4.71
335	0	2	1	0	0	0.6	1.76
336	2	1	0	1	1	1	2.94
337	0	2	0	1	0	0.6	1.76
338	0	2	0	0	0	0.4	1.18
339	0	0	0	0	0	0	0.00
340	0	0	0	0	0	0	0.00
Southbound Total	36	66	25	29	14	34	100%

Figure A1 shows the number of crashes with Wild Animal/Game aggregated per mile for the study section. Approximately 51% of the Wild Animal/Game crashes in the northbound direction between MP 310 and MP 324 and 62% of the Wild Animal/Game crashes in the southbound direction occur between MP 310 and MP 324.

Figure A1 – Wild Animal Crashes By Location



Wildlife crashes were sorted by Time of Year. The results are shown in graphically in Figures A2 and A3. The data indicates that crashes with Wild Animals/Game generally peak in late spring/early summer.

Figure A2 – Total Number of NB Wild Animal Crashes by Month

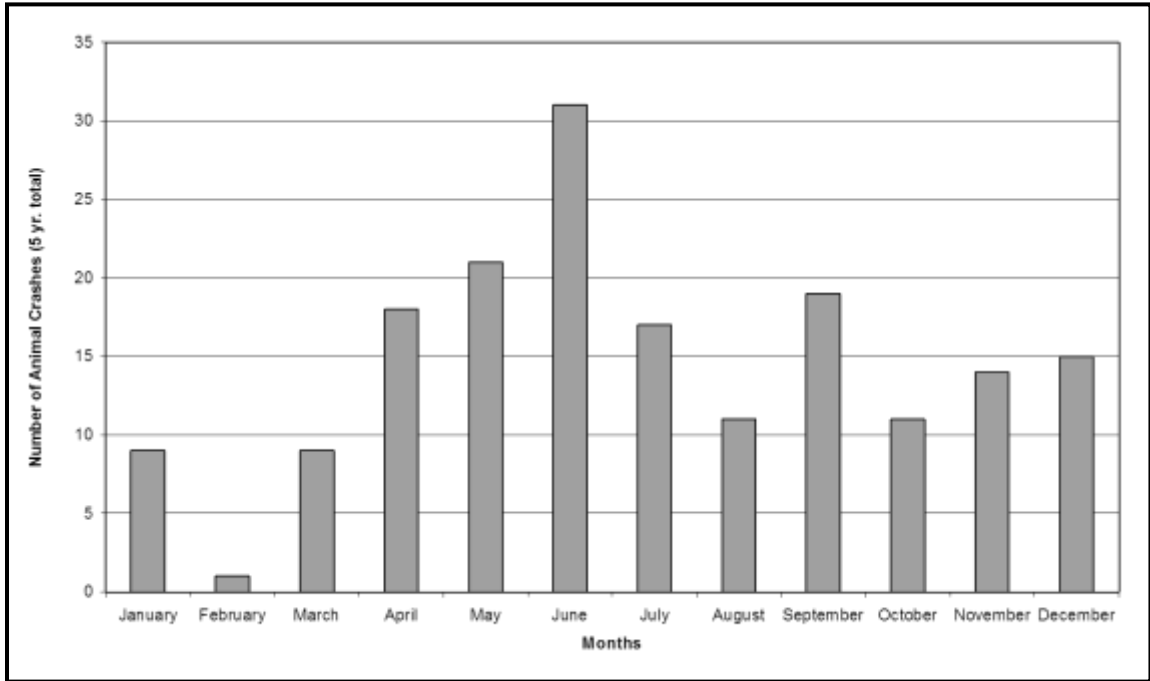
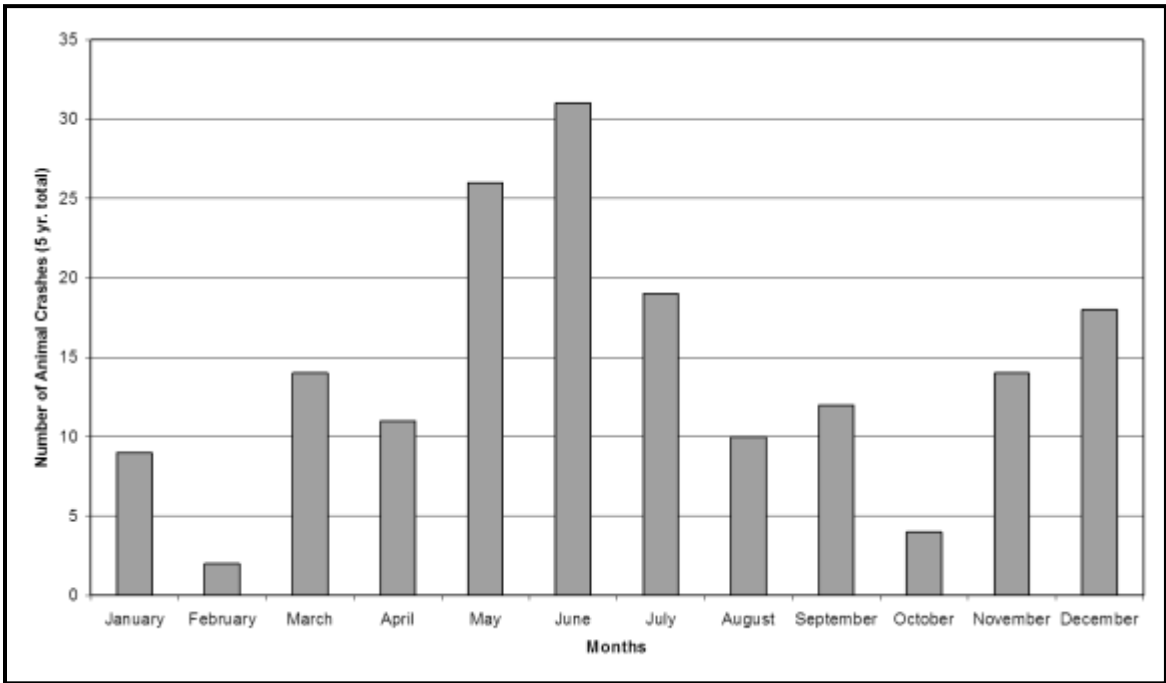


Figure A3 – Total Number of SB Wild Animal Crashes by Month

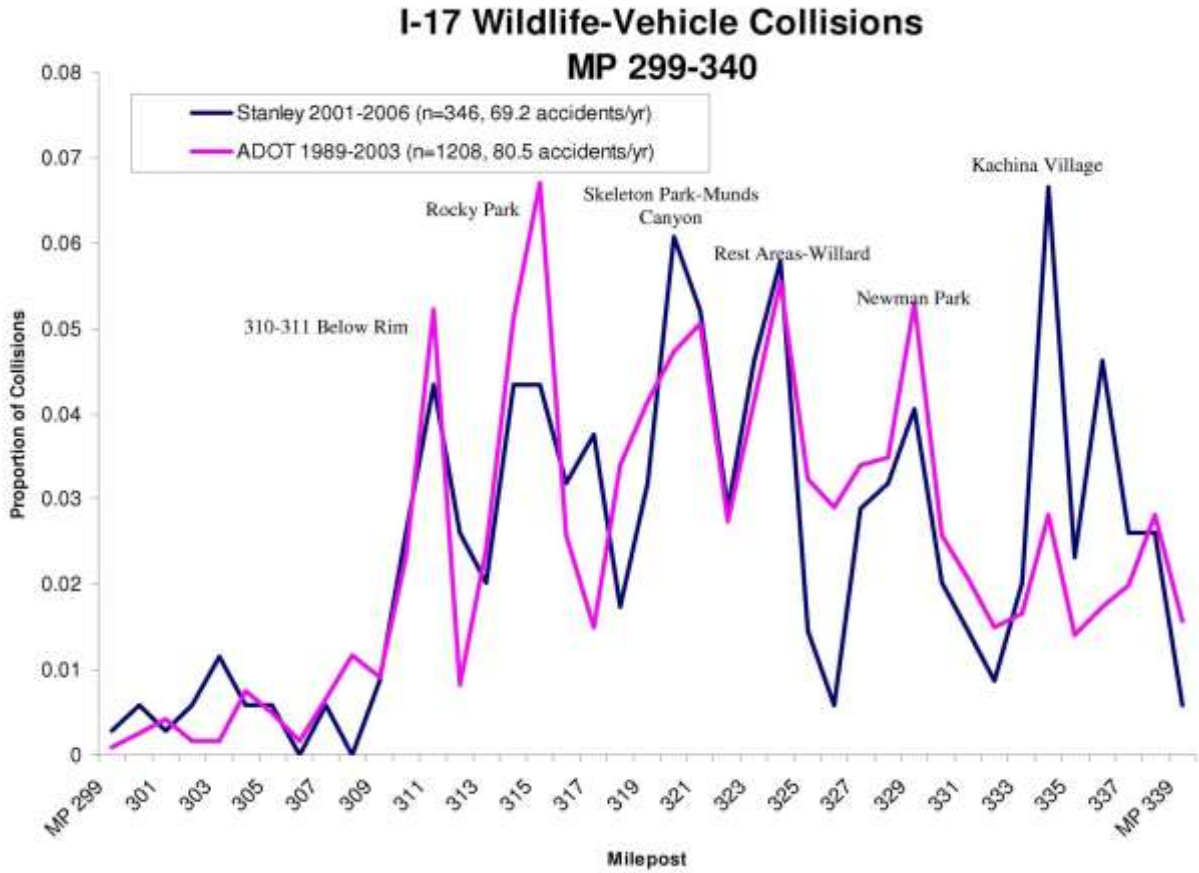


AGFD Crash Data

Apart from the crash data collected and evaluated on behalf of ADOT in the Preliminary Traffic Report (2007), AGFD prepared an independent assessment of crashes using other available crash data. The AGFD data includes a longer reporting period between 1989 and 2003.

Figure A4 shows AGFD’s graph of AGFD and ADOT data.

Figure A4 – AGFD Crash Data



In addition to Figure A4, AGFD data was presented to the study team during the concept development process though the following exhibits.

Figure A5 – AGFD Crash Data

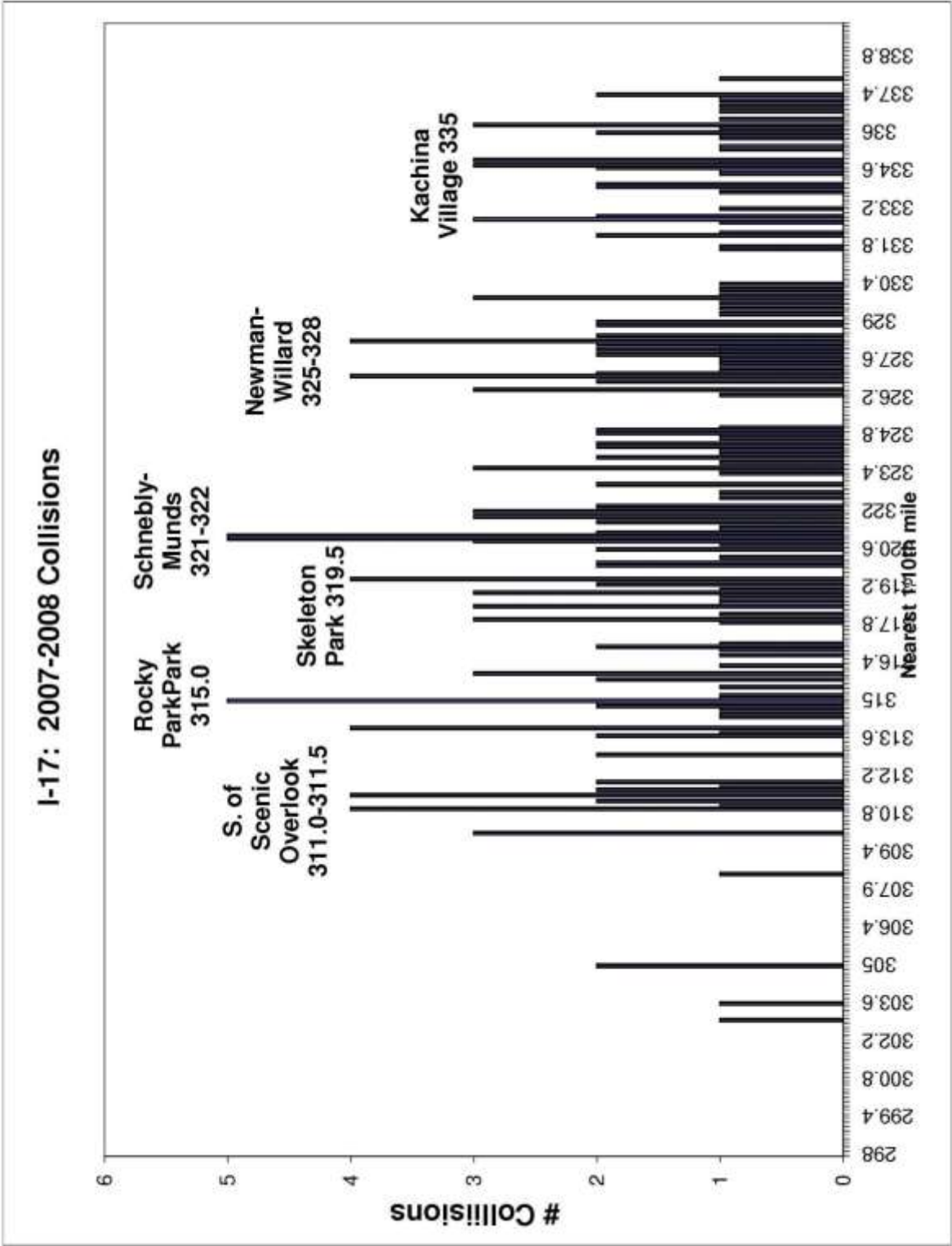
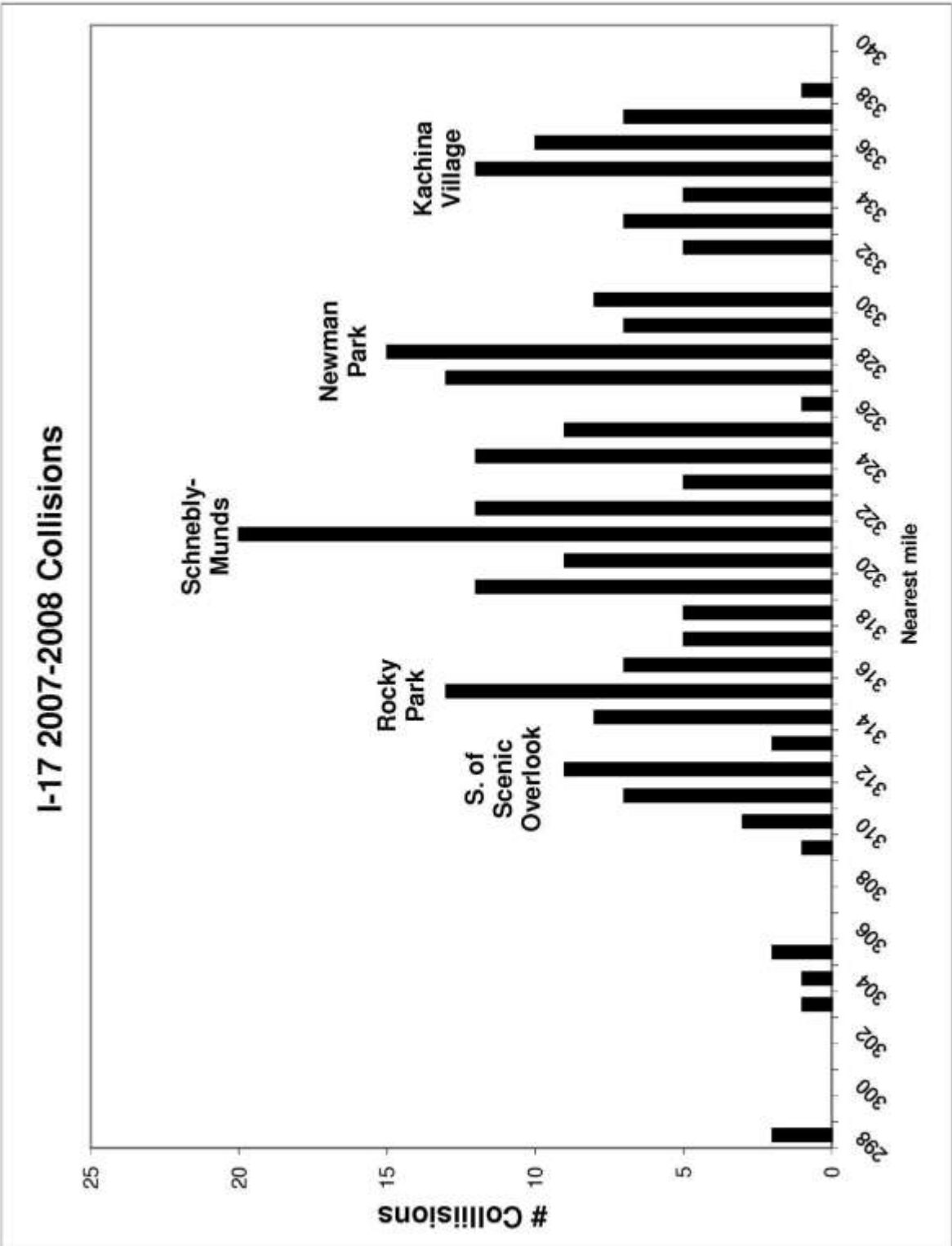


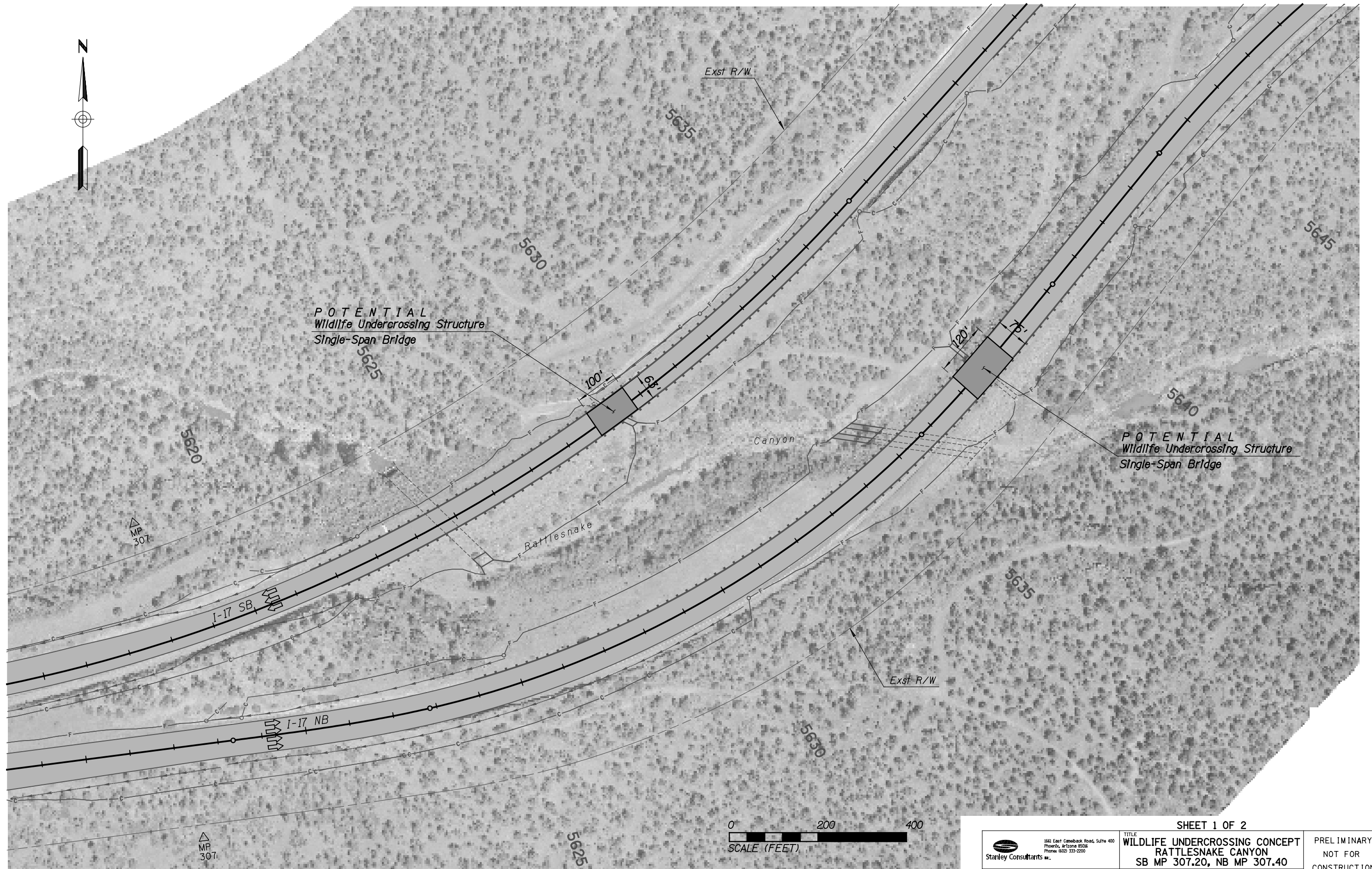
Figure A6 – AGFD Crash Data



APPENDIX W2

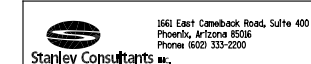
WILDLIFE CROSSING STRUCTURE ALTERNATIVES – CONCEPT LEVEL EXHIBITS

- 1. Recommended Wildlife Crossing Structures**
- 2. Wildlife Crossing Structures Not Recommended**



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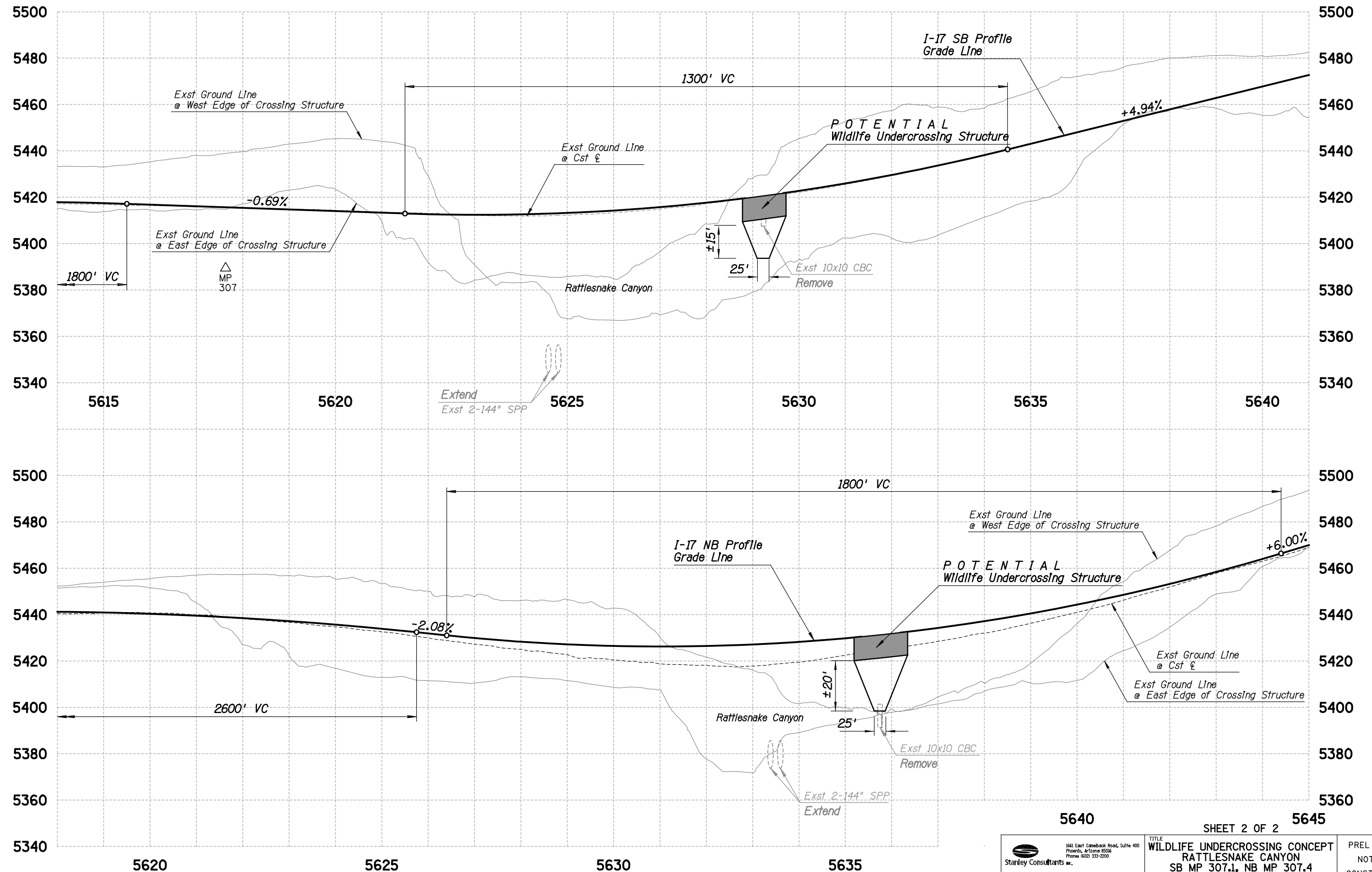
SHEET 1 OF 2

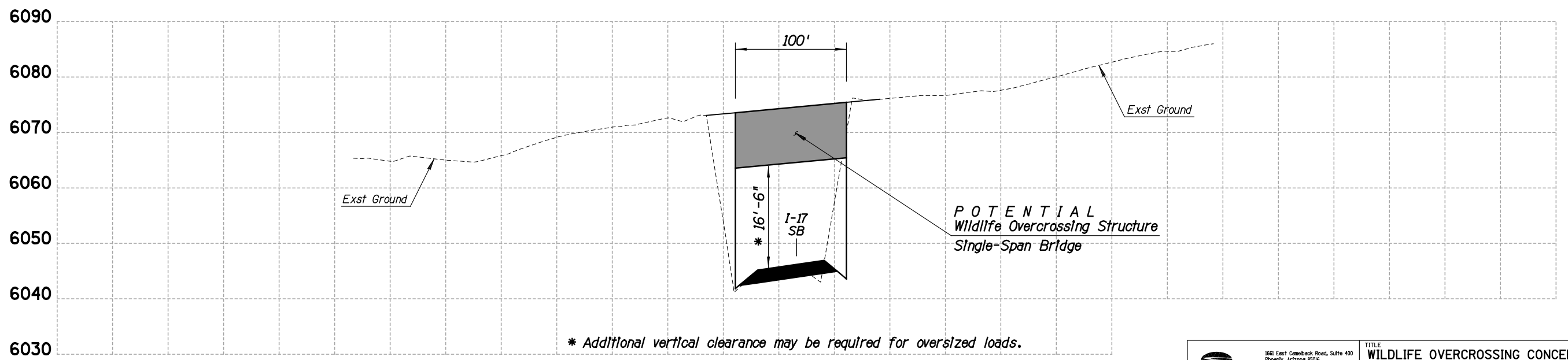


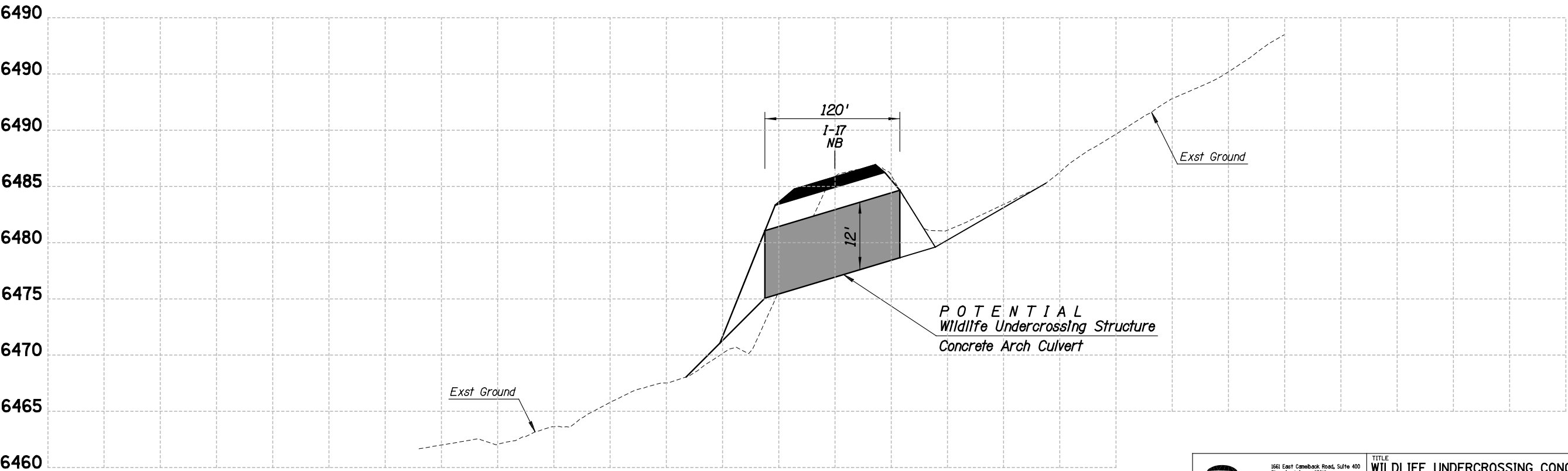
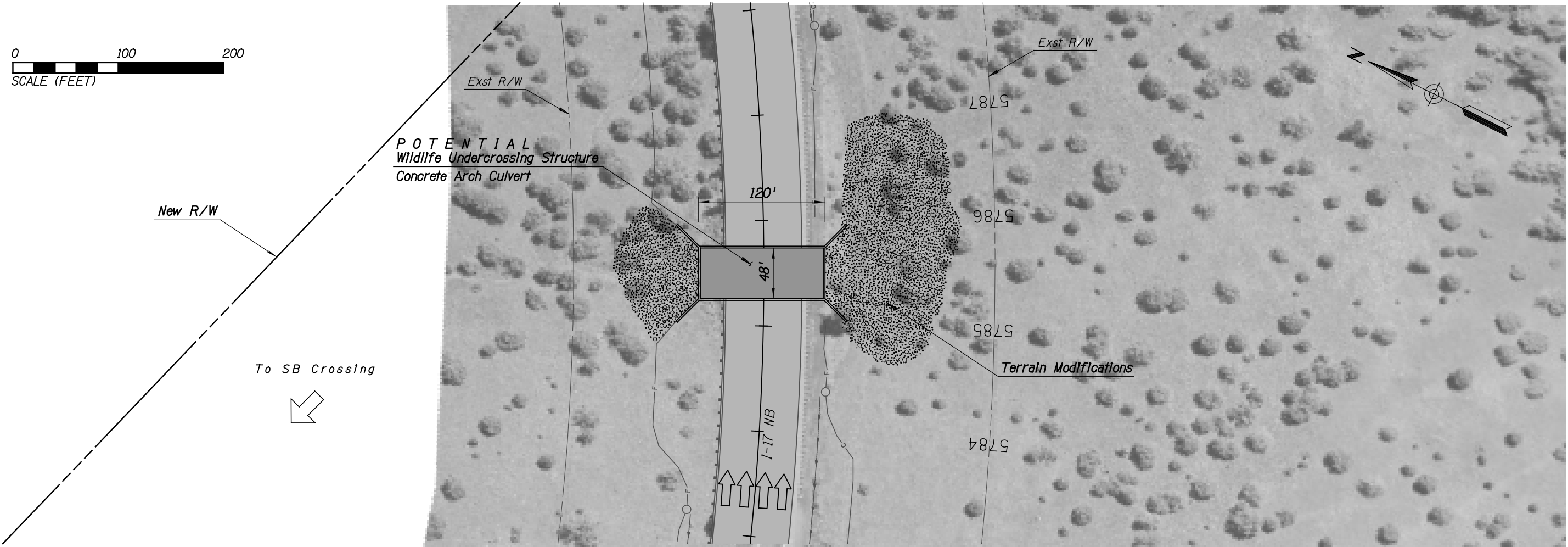
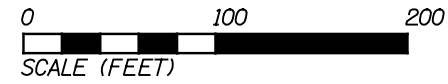
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RATTLESNAKE CANYON
SB MP 307.20, NB MP 307.40**

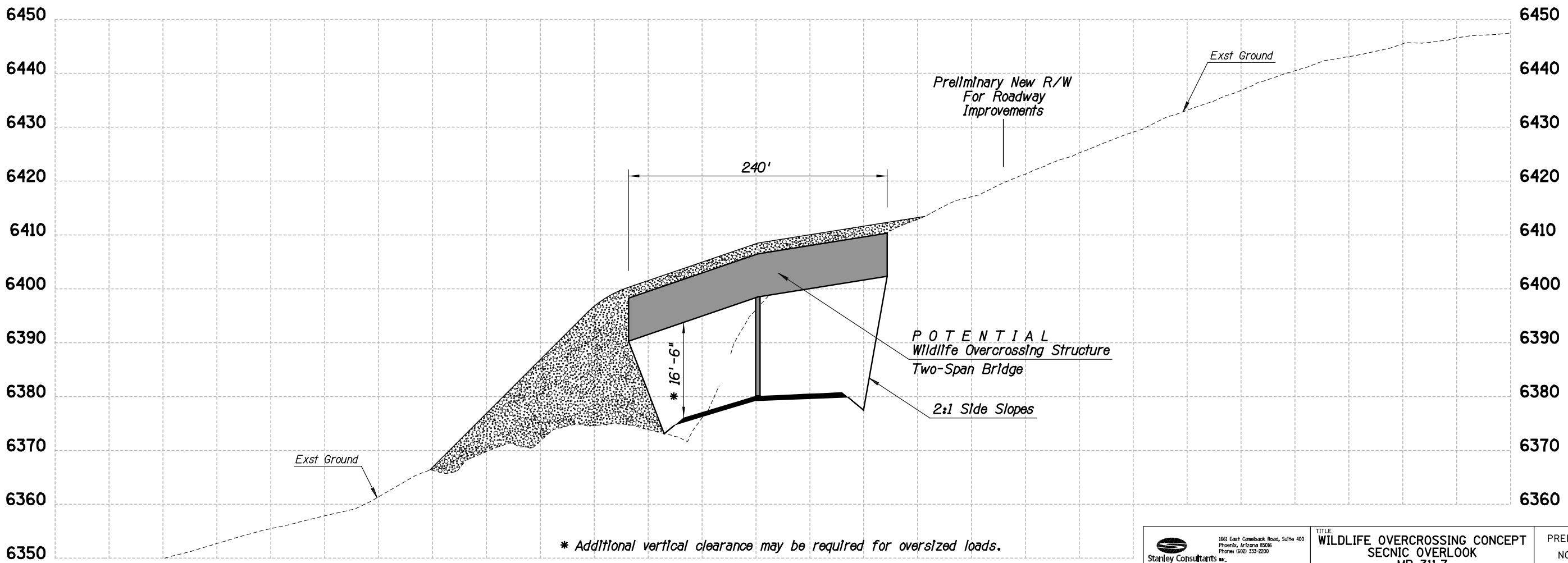
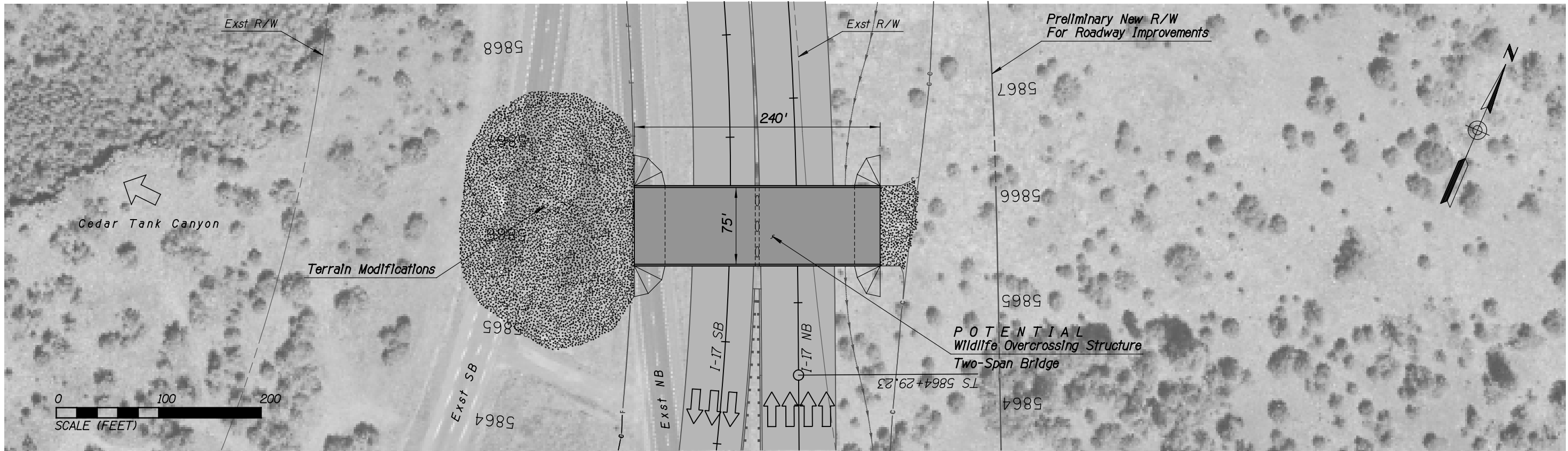
PRELIMINARY
NOT FOR
CONSTRUCTION
OR RECORDING

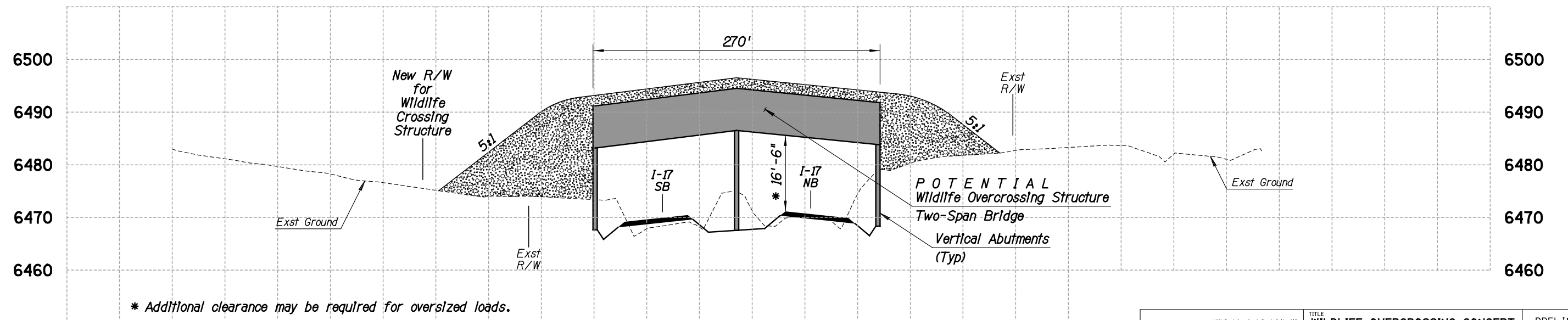
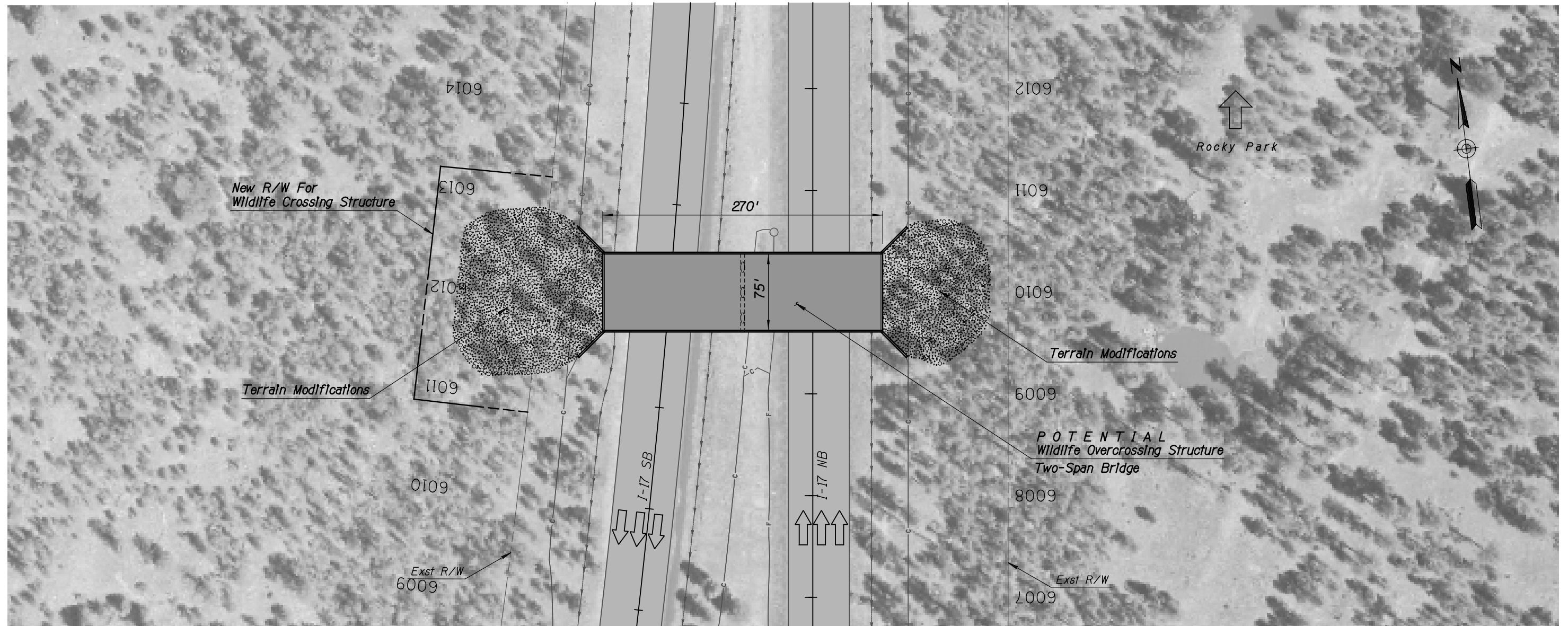
PROJECT
I-17 DCR & ENVIRONMENTAL STUDIES (MP 298.5-340.0)











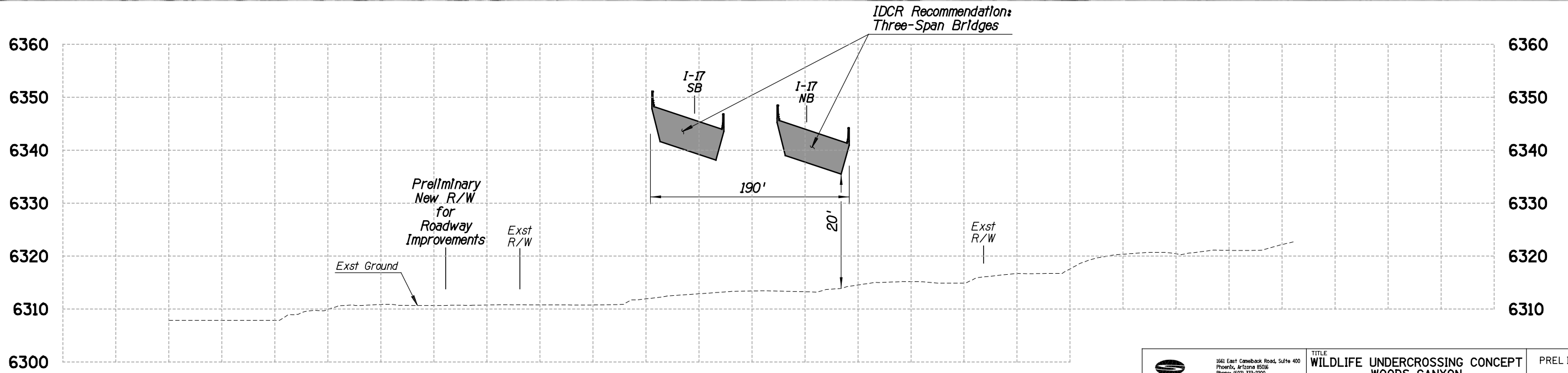
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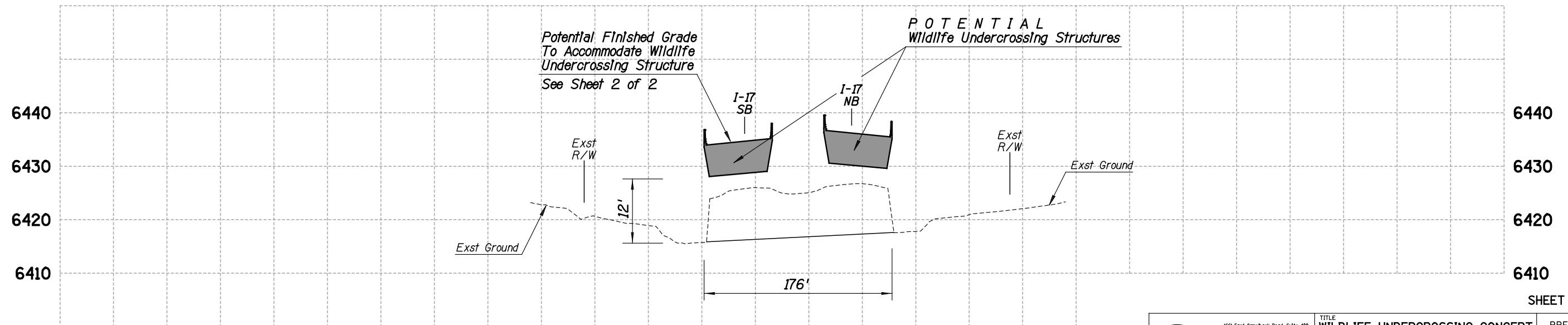
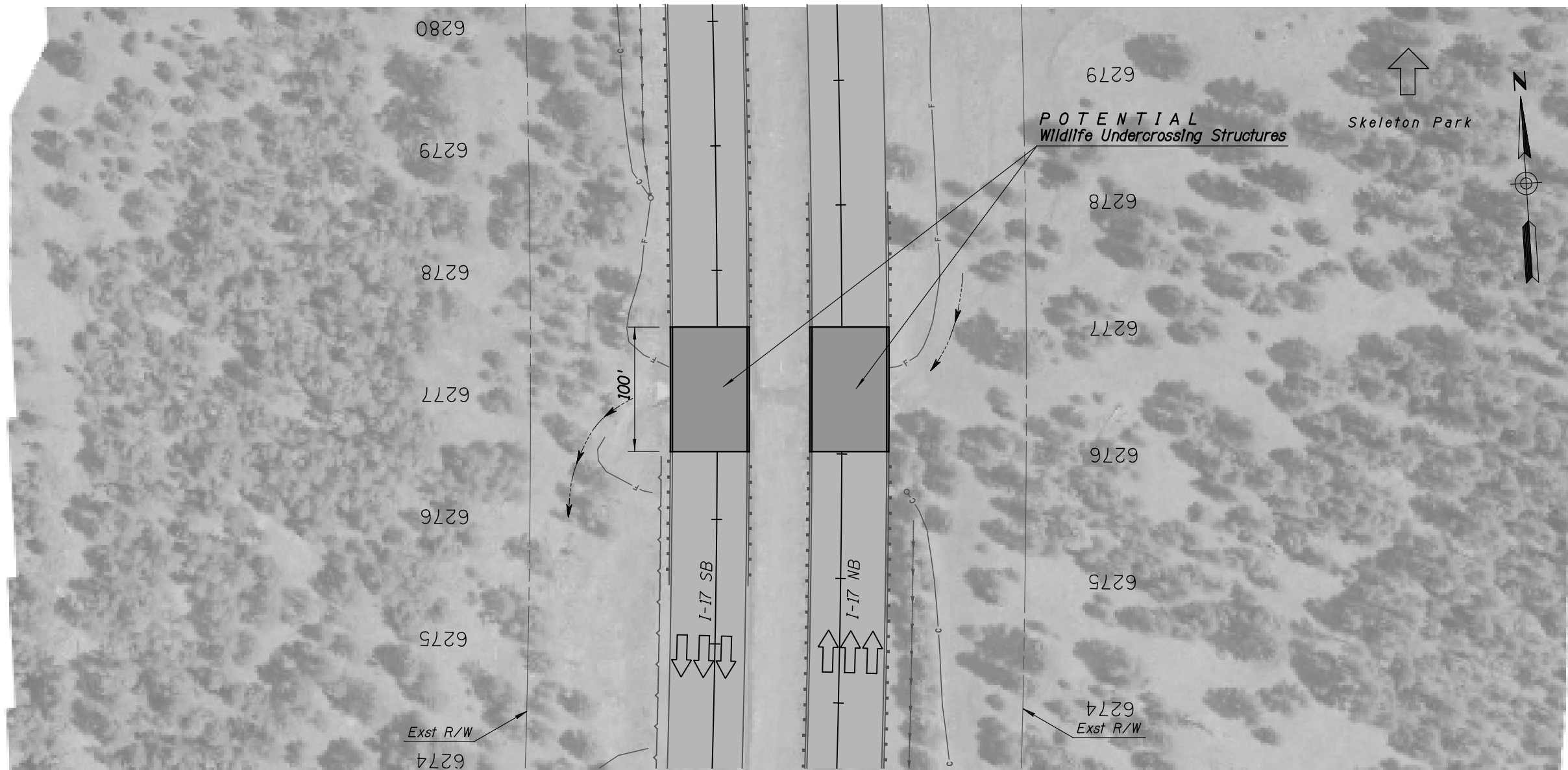
Stanley Consultants Inc.
1561 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

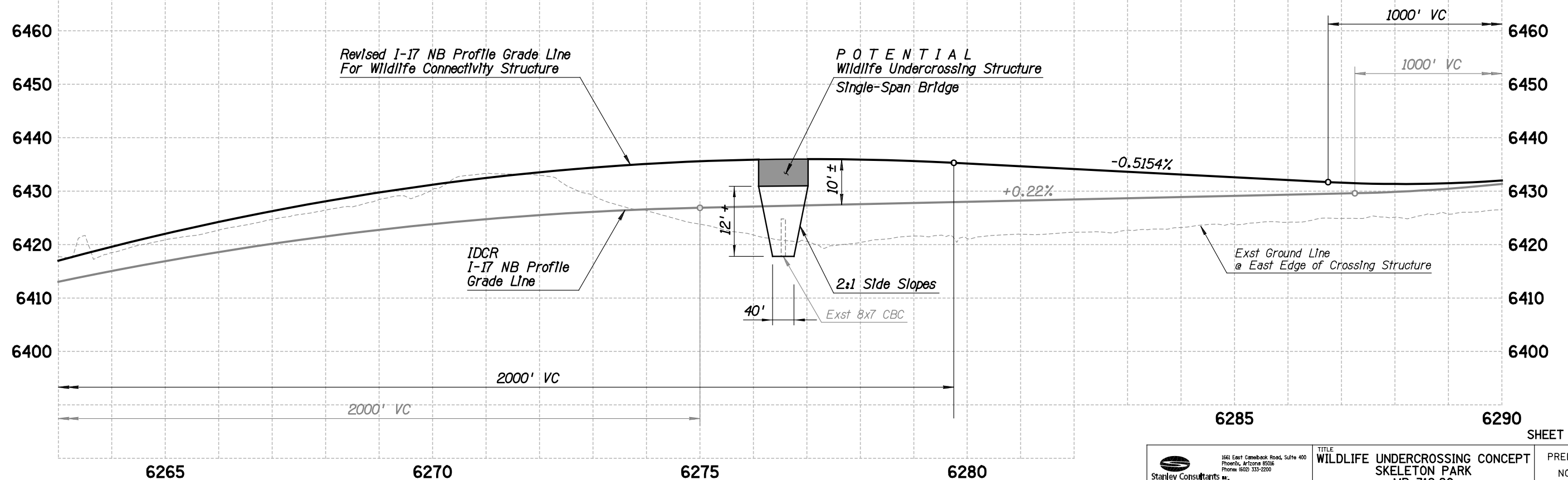
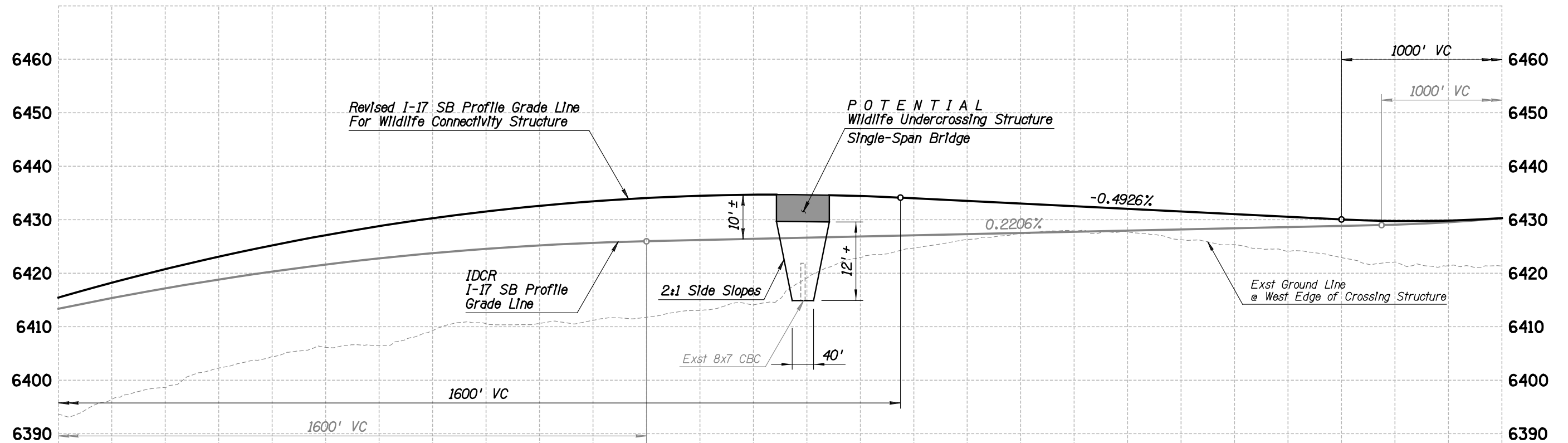
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ROCKY PARK MEADOW
MP 314.4**

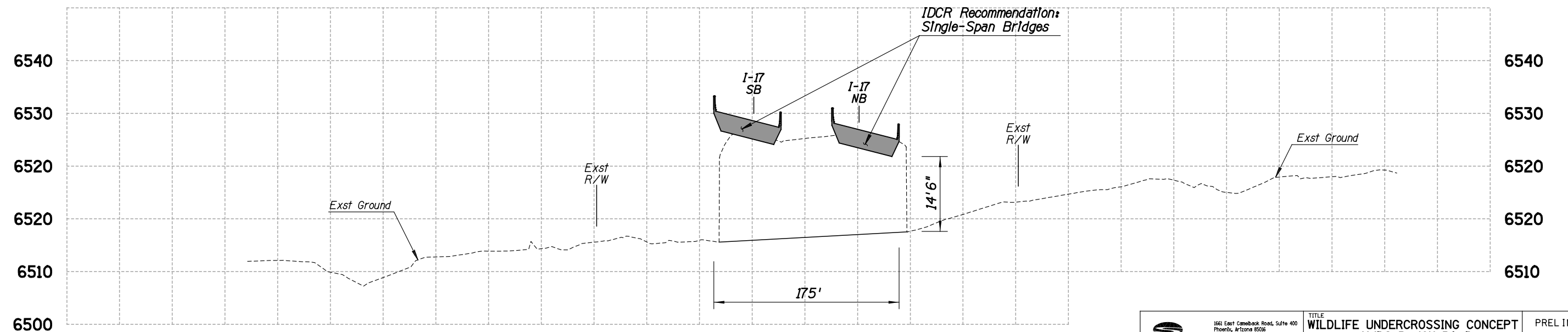
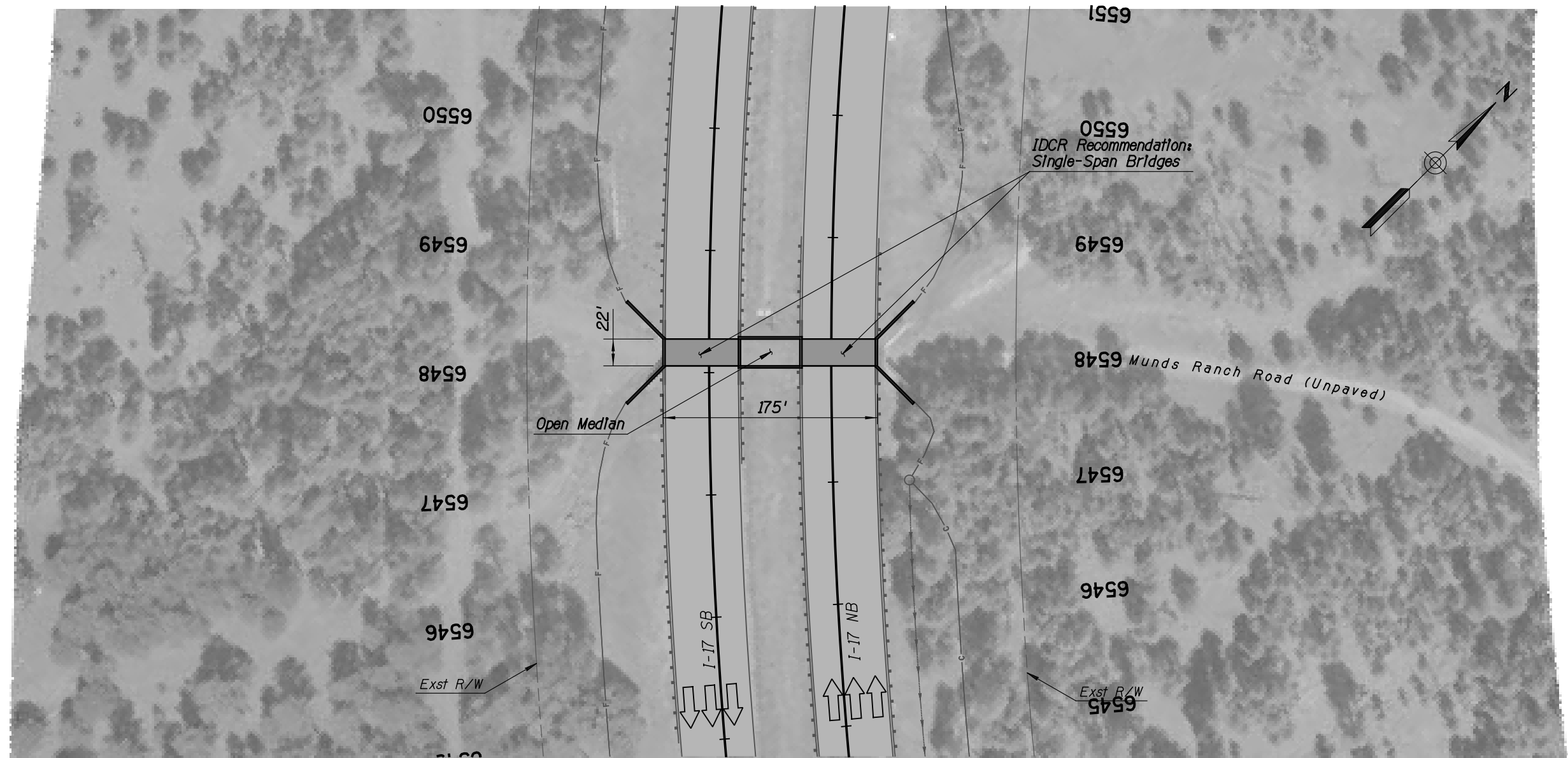
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NOT FOR
CONSTRUCTION
OR RECORDING

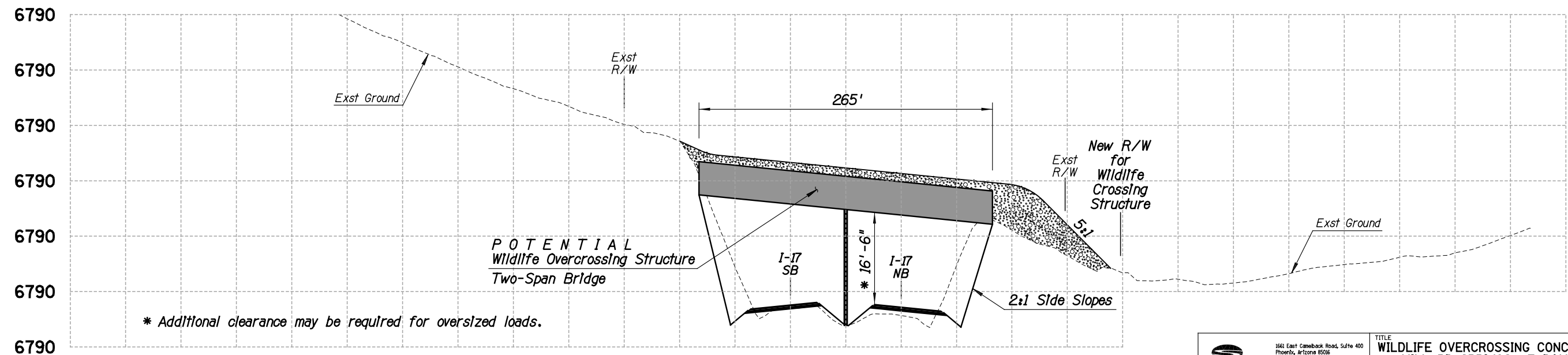
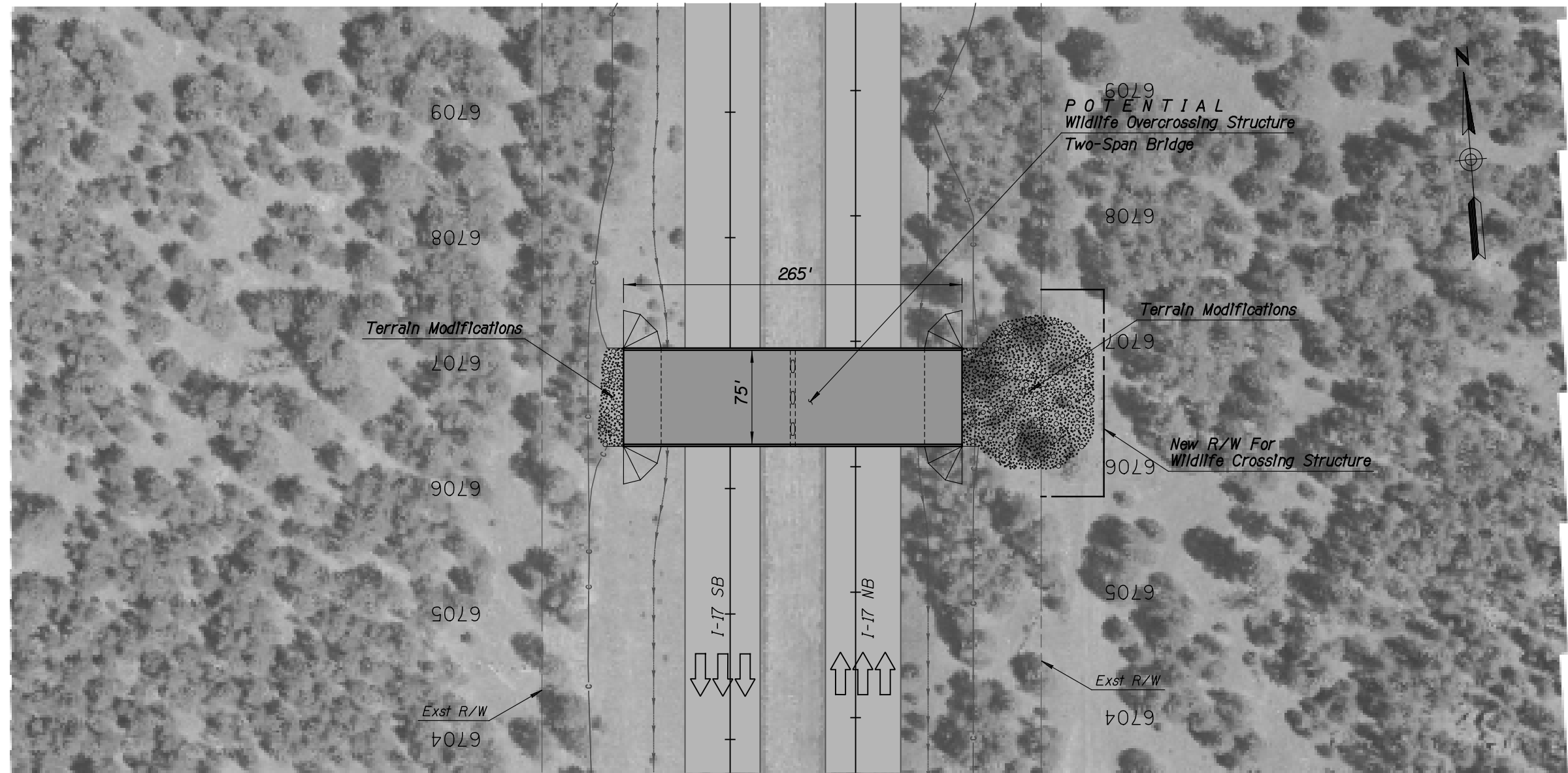
PROJECT
I-17 DCR & ENVIRONMENTAL STUDIES (MP 298.5-340.0)









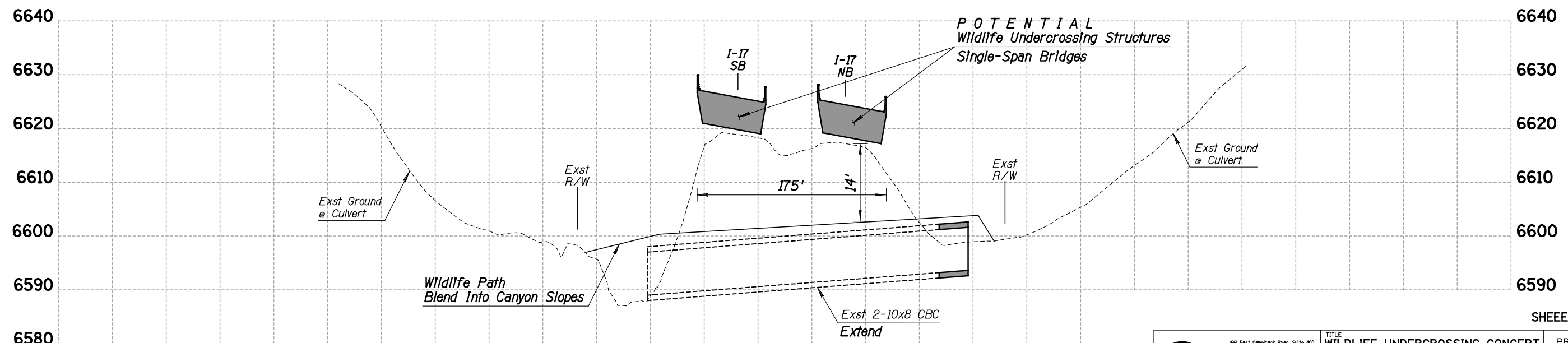
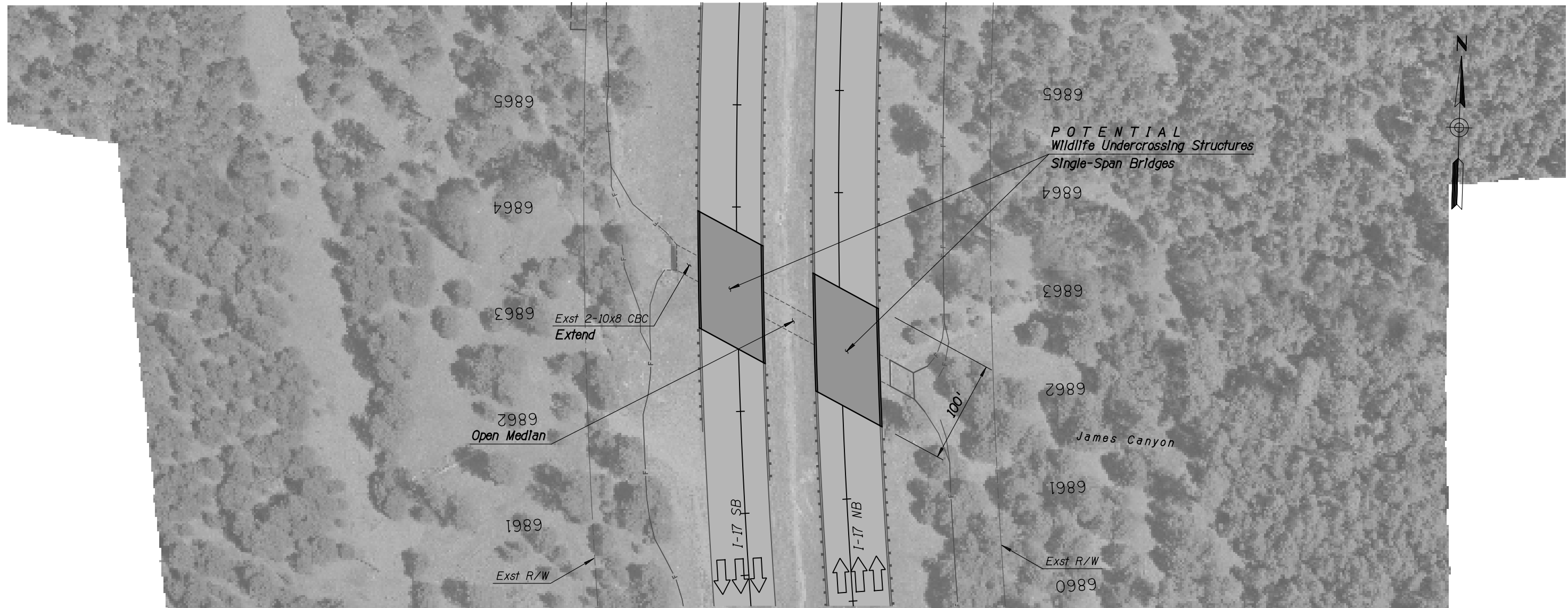


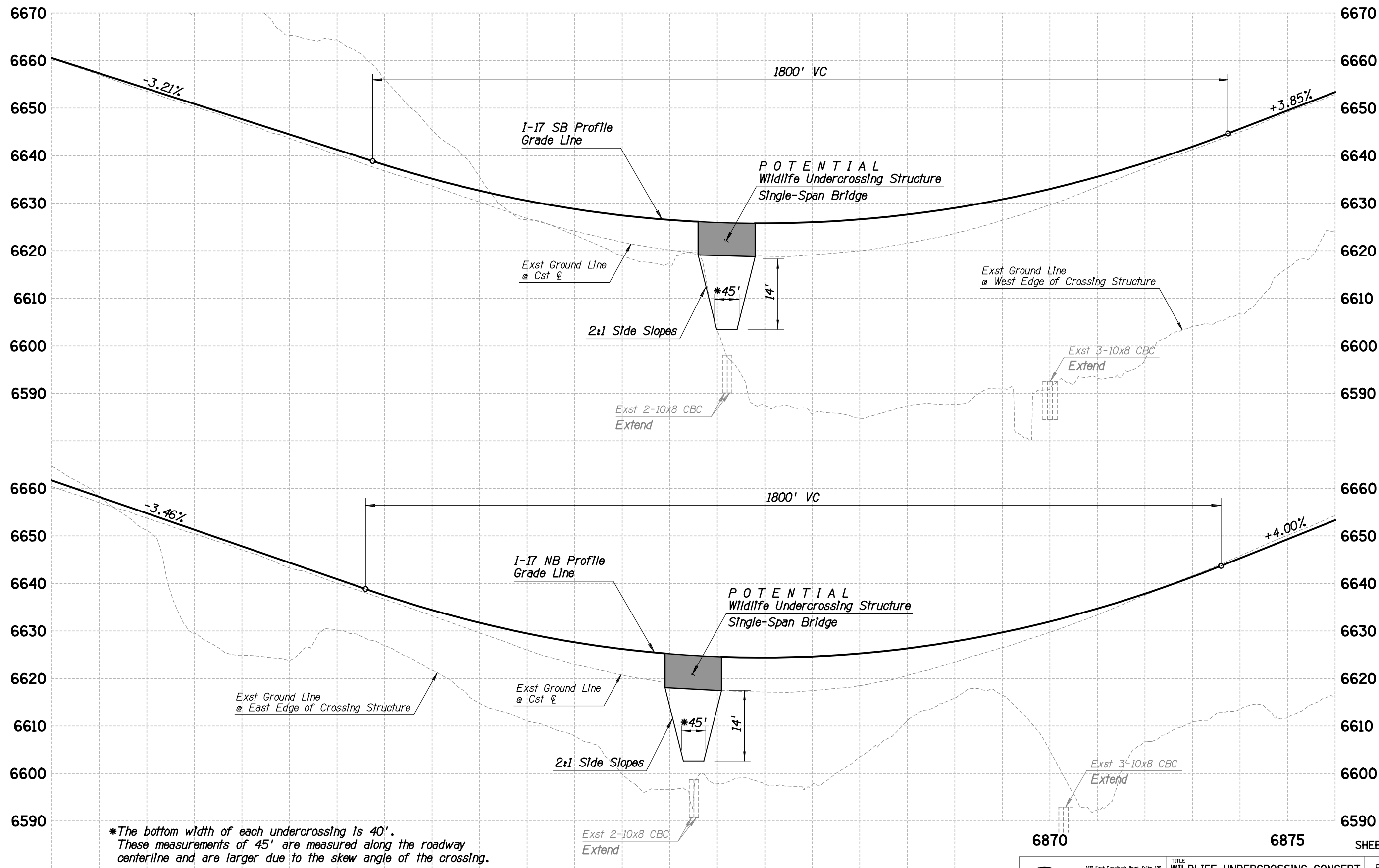
Stanley Consultants Inc.
1561 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

TITLE
**WILDLIFE OVERCROSSING CONCEPT
WILLARD SPRINGS MEADOW
MP 327.4**

PRELIMINARY
NOT FOR
CONSTRUCTION
OR RECORDING

PROJECT
I-17 DCR & ENVIRONMENTAL STUDIES (MP 298.5-340.0)





6850

6855


6860

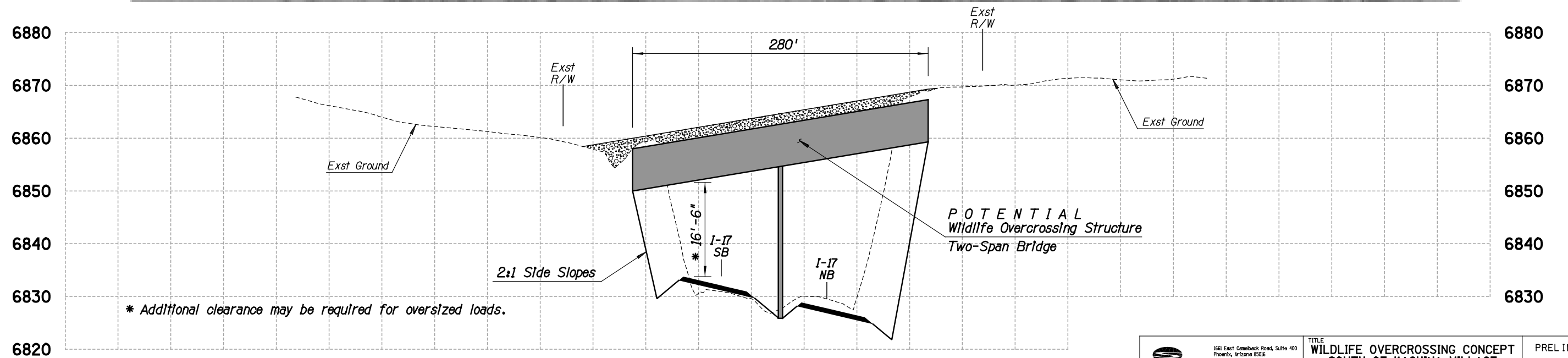
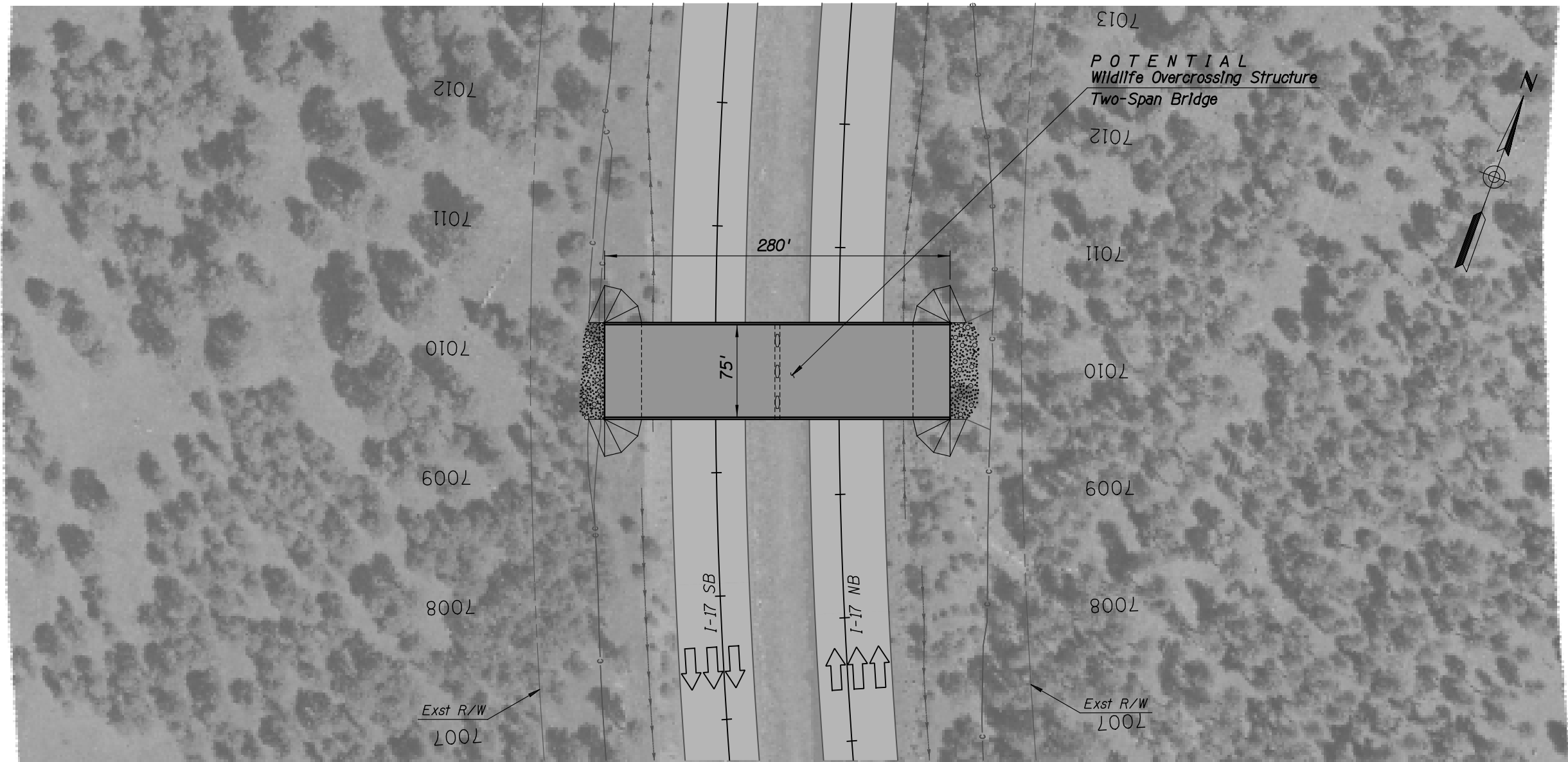
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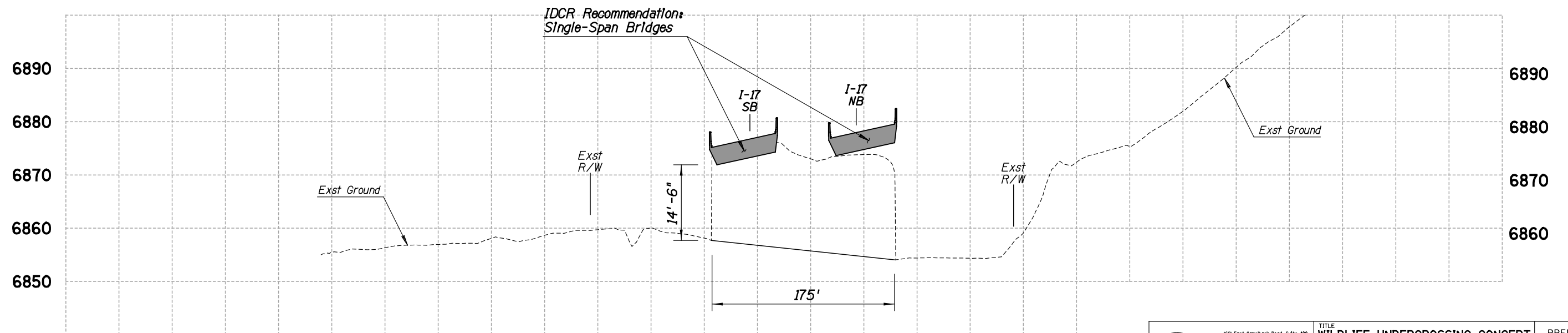
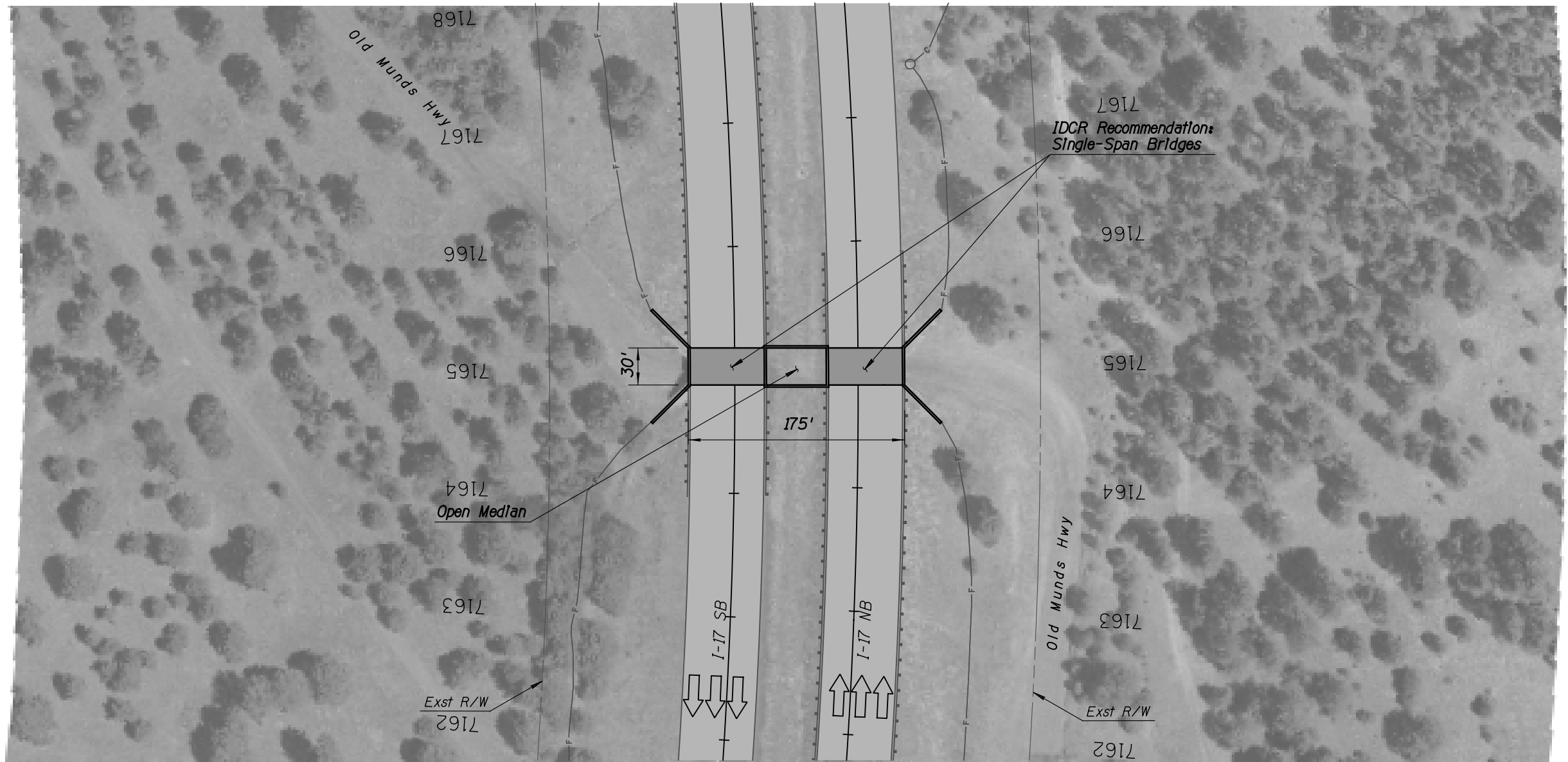
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6875

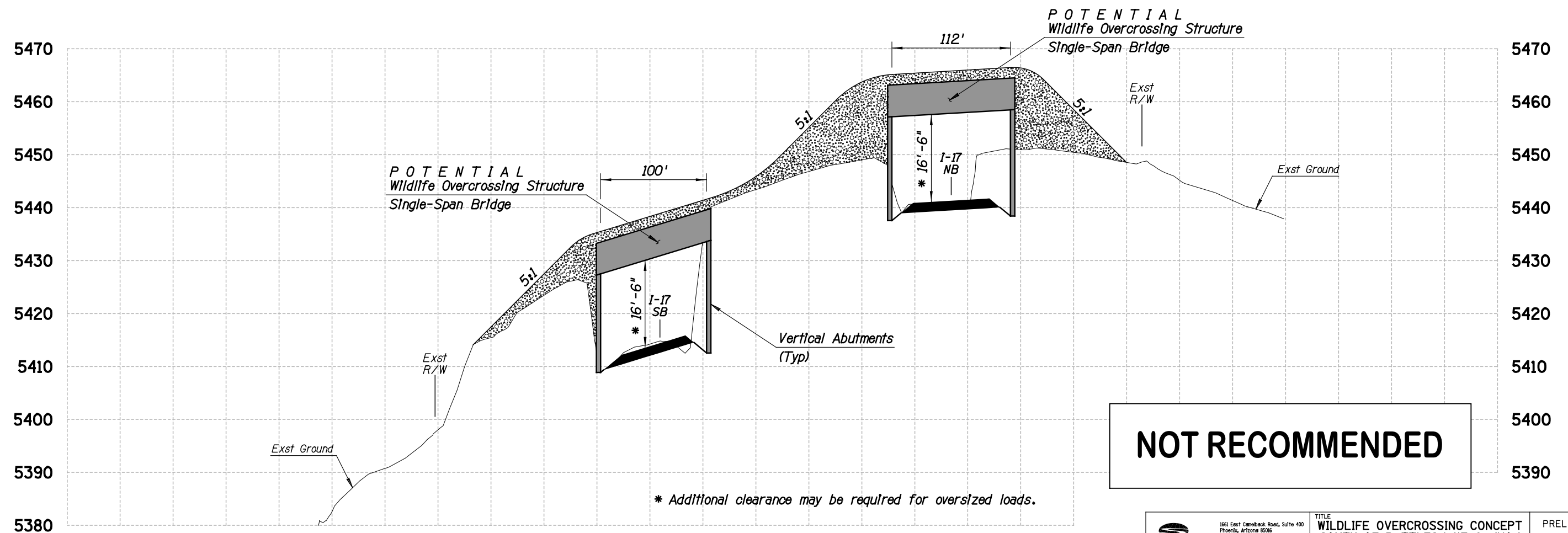
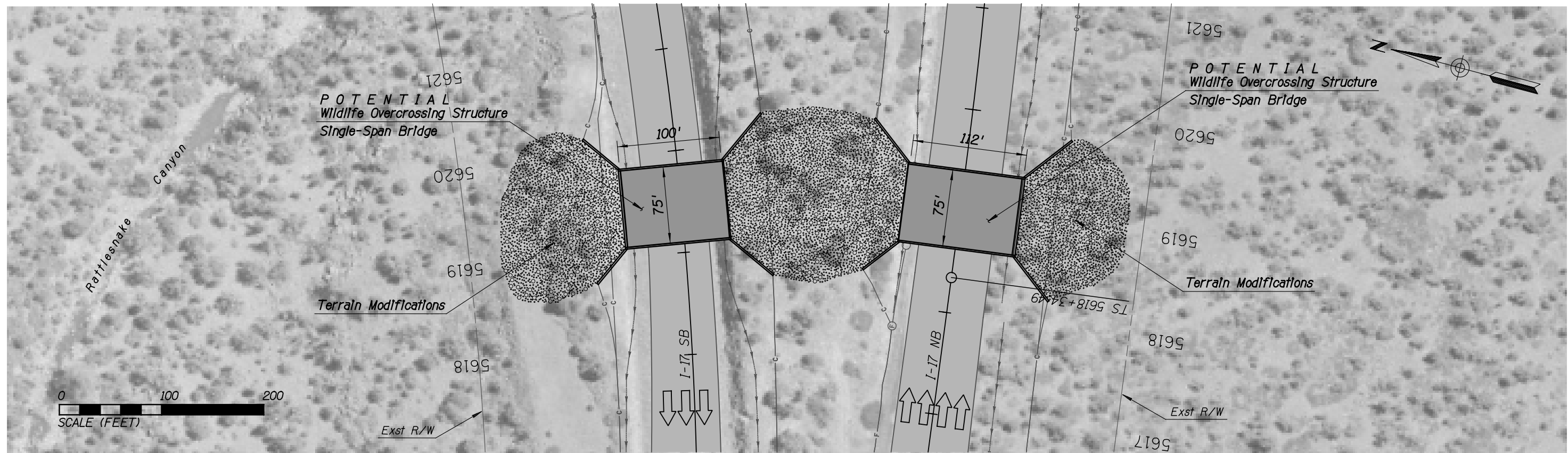
SHEET 2 OF 2

 <p>1561 East Camelback Road, Suite 400 Phoenix, Arizona 85016 Phone: (602) 333-2200</p>	<p>TITLE WILDLIFE UNDERCROSSING CONCEPT JAMES CANYON MP 330.3</p>	<p>PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING</p>
<p>PROJECT I-17 DCR & ENVIRONMENTAL STUDIES (MP 298.5-340.0)</p>		

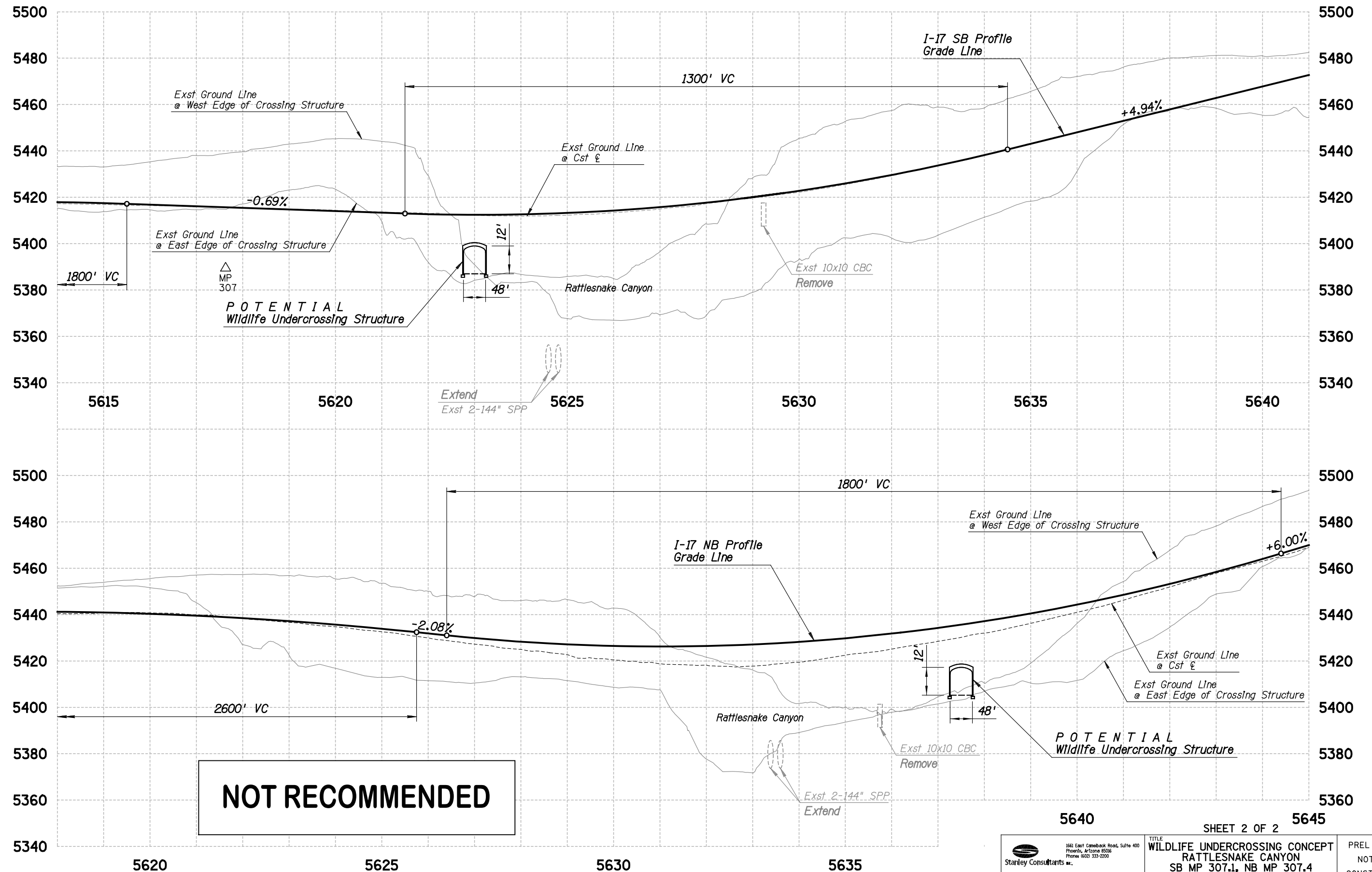


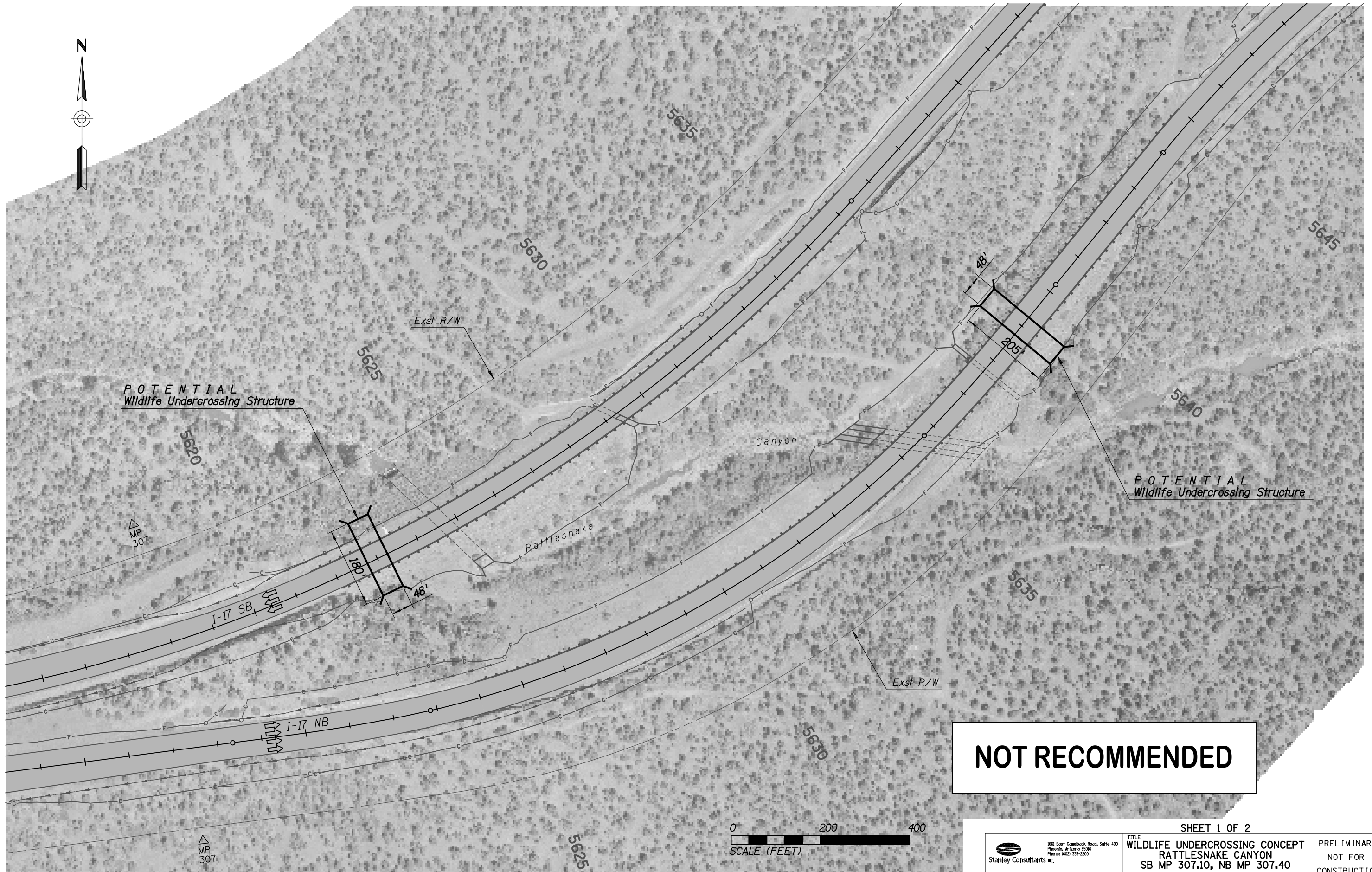


 <p>1661 East Camelback Road, Suite 400 Phoenix, Arizona 85016 Phone: (602) 333-2200</p>	<p>TITLE WILDLIFE UNDERCROSSING CONCEPT OLD MUNDS HWY MP 336.10</p>	<p>PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING</p>
<p>PROJECT I-17 DCR & ENVIRONMENTAL STUDIES (MP 298.5-340.0)</p>		



NOT RECOMMENDED





SHEET 1 OF 2

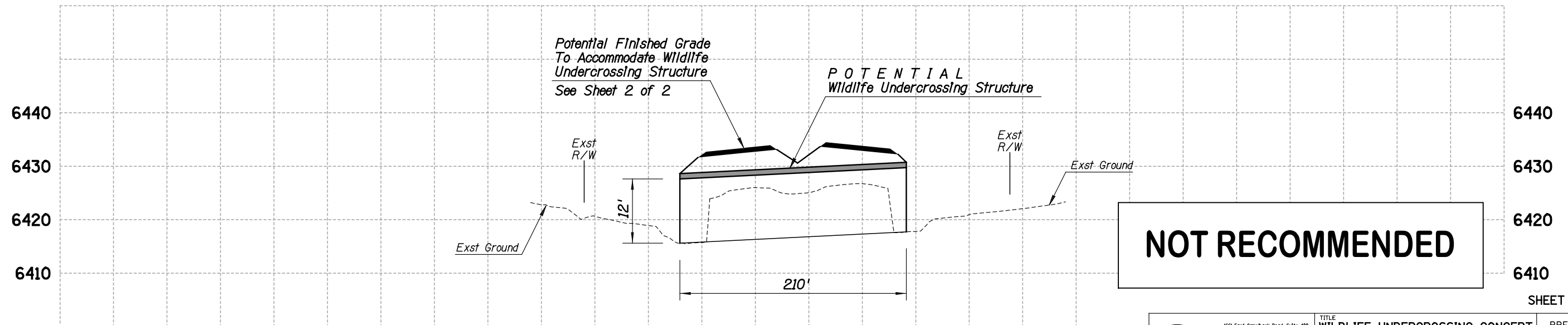
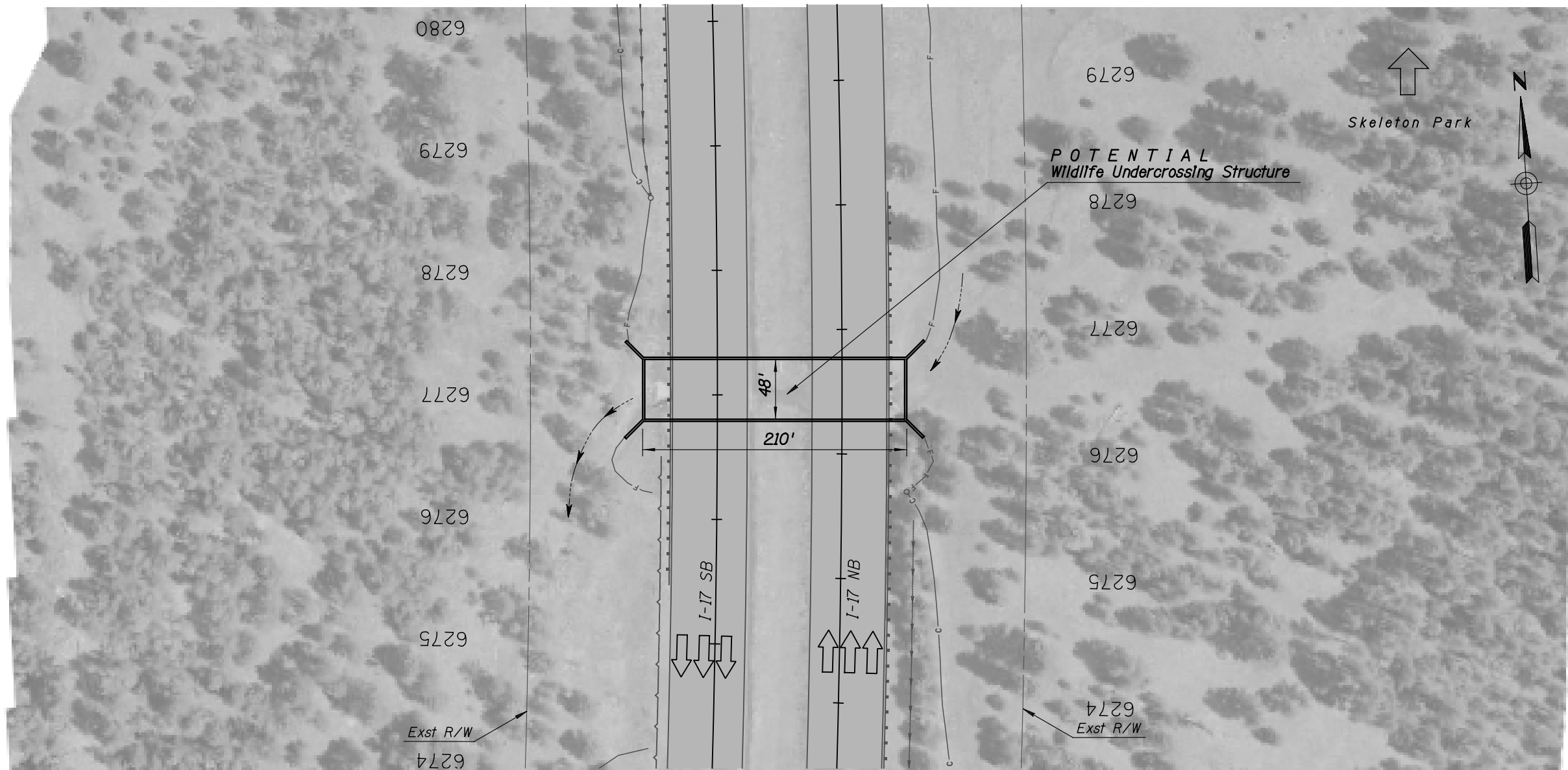


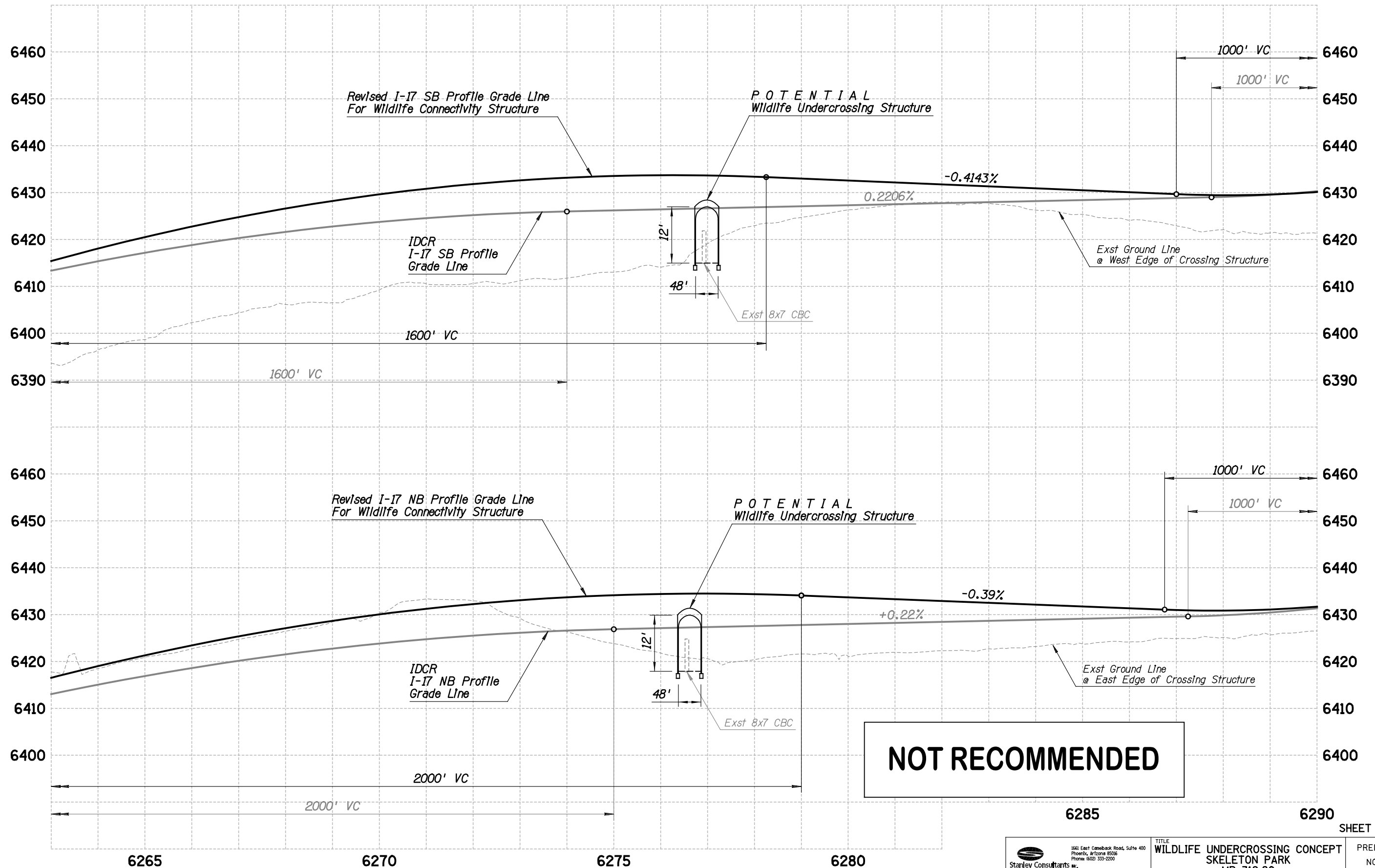
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

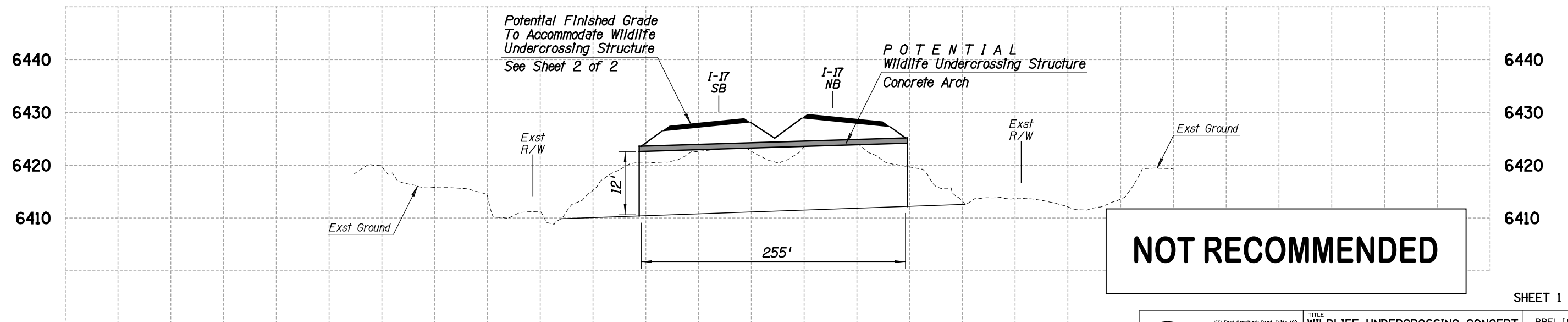
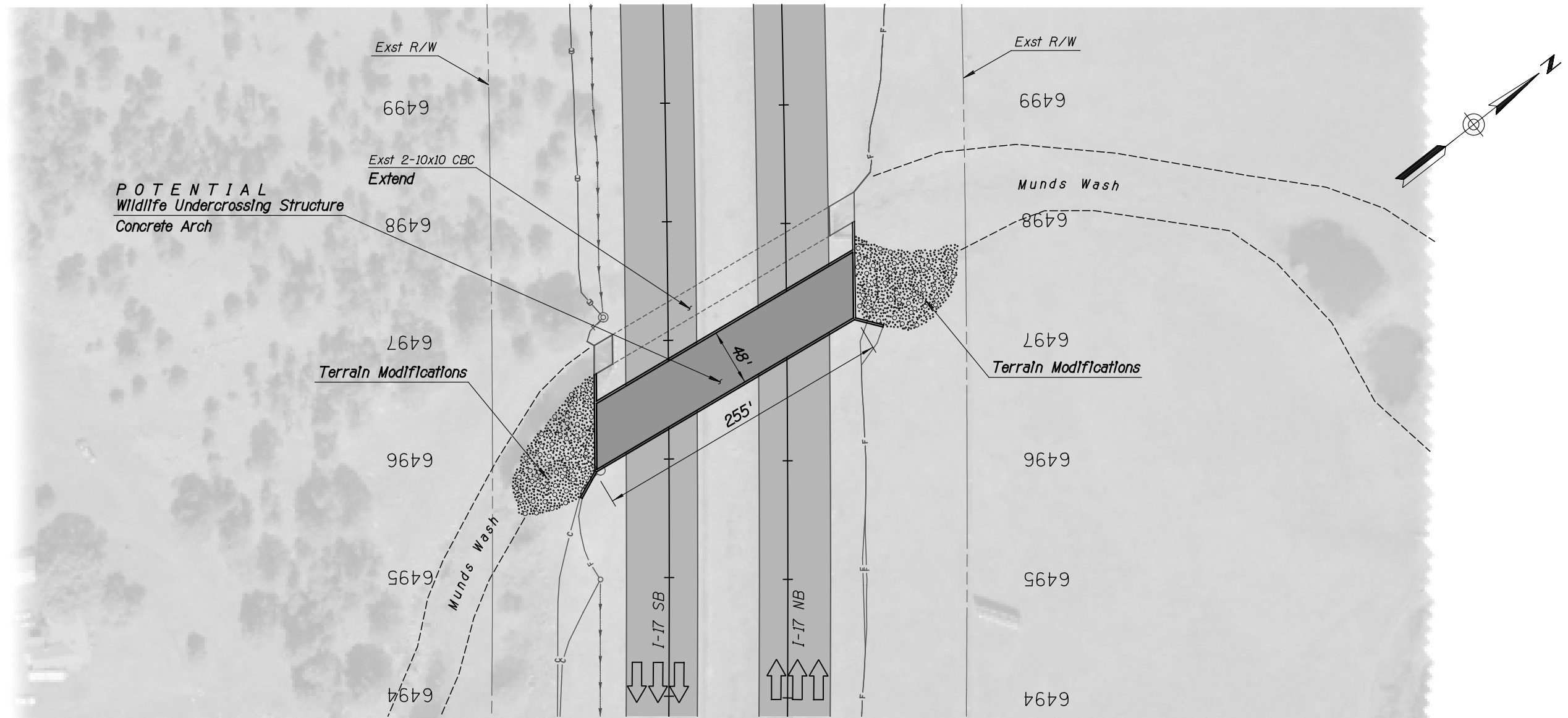
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RATTLESNAKE CANYON
SB MP 307.10, NB MP 307.40**

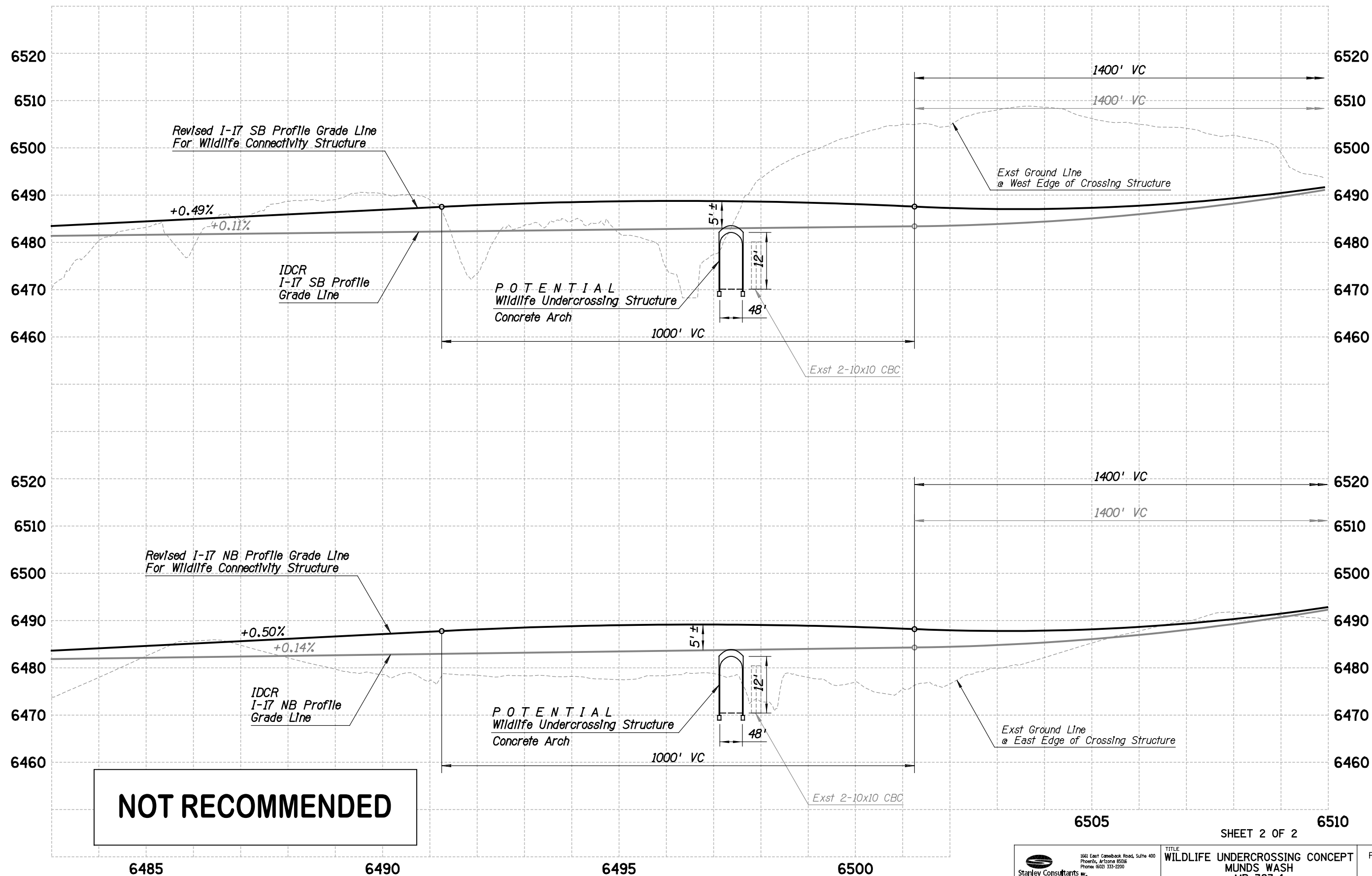
PRELIMINARY
NOT FOR
CONSTRUCTION
OR RECORDING

PROJECT
I-17 DCR & ENVIRONMENTAL STUDIES (MP 298.5-340.0)

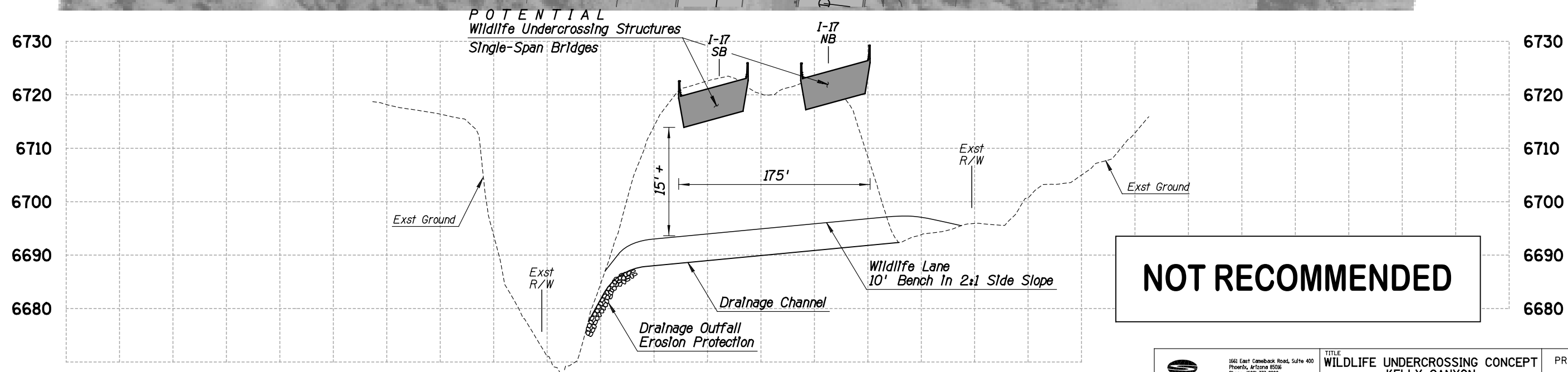
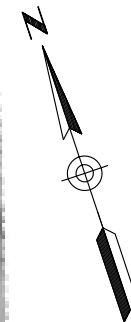
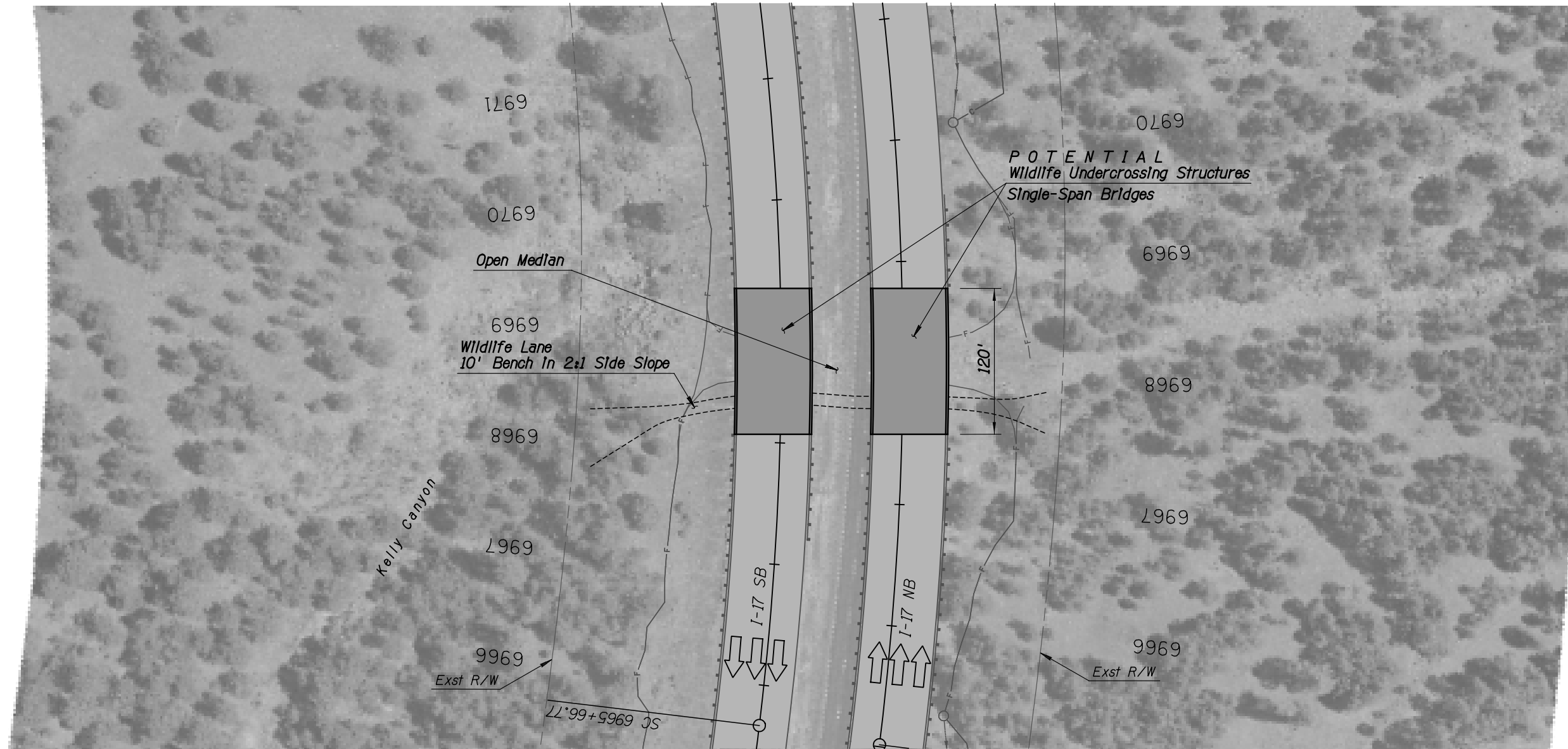







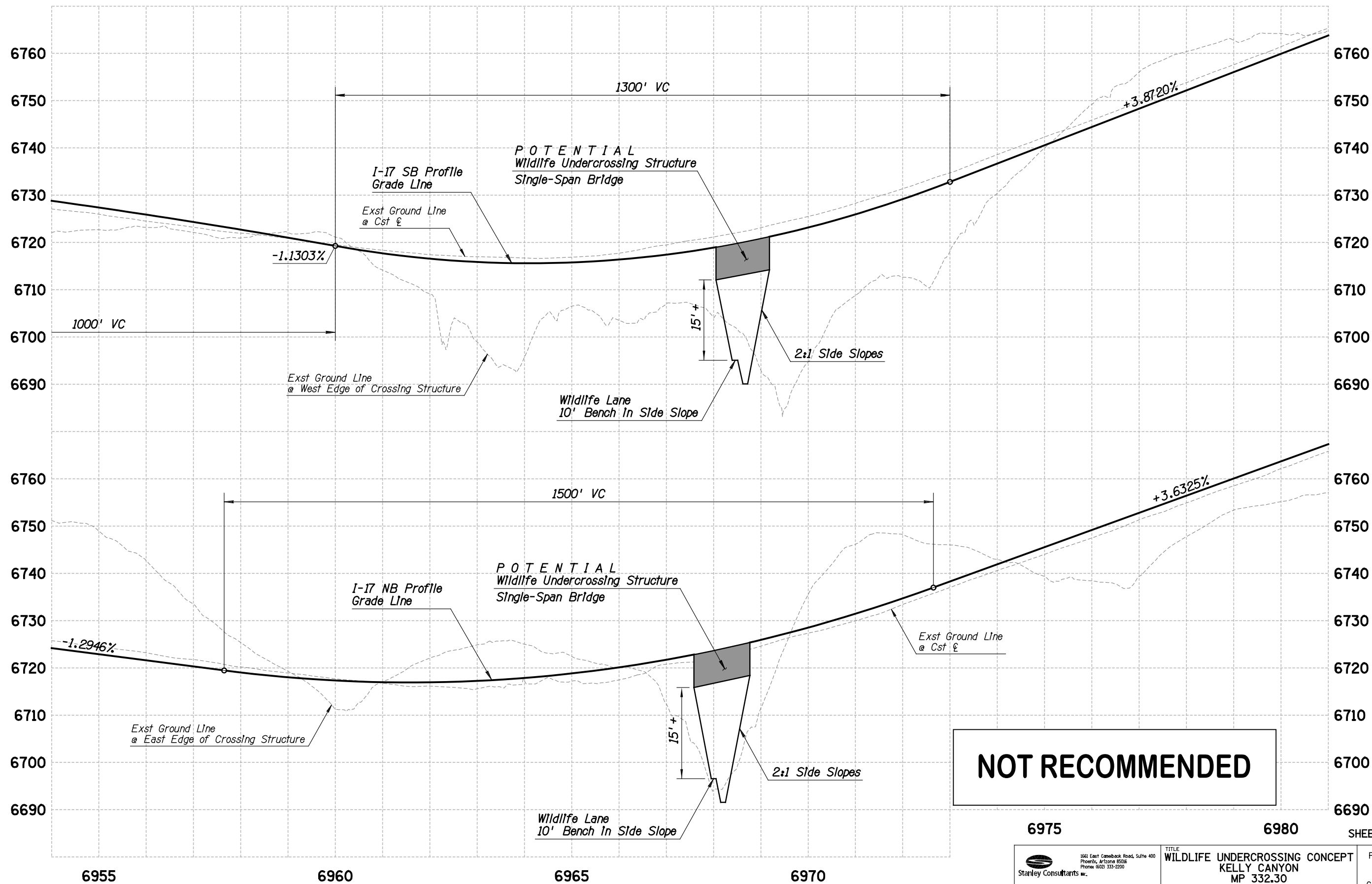


NOT RECOMMENDED



NOT RECOMMENDED

 1561 East Camelback Road, Suite 400 Phoenix, Arizona 85016 Phone: (602) 333-2200	TITLE WILDLIFE UNDERCROSSING CONCEPT KELLY CANYON MP 332.30	PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING
PROJECT I-17 DCR & ENVIRONMENTAL STUDIES (MP 298.5-340.0)		



6975

6980

SHEET 2 OF 2



TITLE
**WILDLIFE UNDERCROSSING CONCEPT
KELLY CANYON
MP 332.30**

PRELIMINARY
NOT FOR
CONSTRUCTION
OR RECORDING

PROJECT
I-17 DCR & ENVIRONMENTAL STUDIES (MP 298.5-340.0)

APPENDIX W3

WILDLIFE CROSSING STRUCTURE ALTERNATIVES – CONCEPT LEVEL COST ESTIMATES

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: SOUTH OF RATTLESNAKE CANYON (MP 307.0)

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE BRIDGE OVERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
2030900	BORROW (IN-PLACE)	CU.YD.	10,000	\$ 3.00	\$ 30,000
80xxxxx	LANDSCAPING	L.SUM	1	\$ 50,000.00	\$ 50,000
9140155	RETAINING WALL (CONCRETE)	SQ.FT.	8,000	\$ 60.00	\$ 480,000
99xxxxx	STRUCTURE	SQ.FT.	15,900	\$ 150.00	\$ 2,385,000
ROADWAY ITEMS SUBTOTAL					\$ 2,945,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 442,000
SUBTOTAL					\$ 3,387,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 34,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 34,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (6%)	COST	6%		\$ 203,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 34,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 68,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 34,000
SUBTOTAL					\$ 3,794,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 379,000
SUBTOTAL					\$ 4,173,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 626,000
951X002	CONTINGENCY	COST	5%		\$ 209,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 217,000
ROADWAY ITEMS					\$ 5,225,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 418,000
	RIGHT-OF-WAY	L.SUM			\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 418,000

Summary	
Section	Total
ROADWAY ITEMS	\$5,225,000
PROJECT WIDE	\$
OTHER COST	\$418,000
Total Project Cost	\$5,600,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: RATTLESNAKE CANYON (SB MP 307.1, NB MP 307.3)

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE DUAL CULVERT UNDERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
2020301	ROADWAY EXCAVATION	CU.YD.	50,000	\$ 10.00	\$ 500,000
80xxxxx	LANDSCAPING	L.SUM	-	\$ 50,000.00	\$ -
99xxxxx	CONCRETE ARCH STRUCTURE	L.FT.	385	\$ 10,000.00	\$ 3,850,000
ROADWAY ITEMS SUBTOTAL					\$ 4,350,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 653,000
SUBTOTAL					\$ 5,003,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 50,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 50,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (15%)	COST	15%		\$ 750,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 50,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 100,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 50,000
SUBTOTAL					\$ 6,053,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 605,000
SUBTOTAL					\$ 6,658,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 999,000
951X002	CONTINGENCY	COST	5%		\$ 333,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 346,000
ROADWAY ITEMS					\$ 8,336,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 667,000
	RIGHT-OF-WAY	L.SUM			\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 667,000

Summary	
Section	Total
ROADWAY ITEMS	\$8,336,000
PROJECT WIDE	\$
OTHER COST	\$667,000
Total Project Cost	\$9,000,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: RATTLESNAKE CANYON (MP 307.2 SB & 307.4 NB)

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE BRIDGE OVERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
2020014	REMOVAL OF STRUCTURES (EXST BOX CULVERT)	L.SUM	2	\$ 15,000.00	\$ 30,000
2020301	ROADWAY EXCAVATION	CU.YD.	15,000	\$ 10.00	\$ 150,000
2030900	BORROW (IN-PLACE)	CU.YD.	-	\$ 10.00	\$ -
80xxxxx	LANDSCAPING	L.SUM	1	\$ 50,000.00	\$ 50,000
99xxxxx	STRUCTURE	SQ.FT.	15,300	\$ 140.00	\$ 2,142,000
ROADWAY ITEMS SUBTOTAL					\$ 2,372,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 356,000
SUBTOTAL					\$ 2,728,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 27,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 27,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (15%)	COST	15%		\$ 409,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 27,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 55,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 27,000
SUBTOTAL					\$ 3,300,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 330,000
SUBTOTAL					\$ 3,630,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 545,000
951X002	CONTINGENCY	COST	5%		\$ 182,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 188,000
ROADWAY ITEMS					\$ 4,545,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 364,000
	RIGHT-OF-WAY	L.SUM			\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 364,000

Summary	
Section	Total
ROADWAY ITEMS	\$4,545,000
PROJECT WIDE	\$
OTHER COST	\$364,000
Total Project Cost	\$4,900,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: WIDE MEDIAN (MP 309.8) SB

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE BRIDGE OVERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
2030900	BORROW (IN-PLACE)	CU.YD.	2,000	\$ 10.00	\$ 20,000
80xxxxx	LANDSCAPING	L.SUM	1	\$ 50,000.00	\$ 50,000
99xxxxx	STRUCTURE	SQ.FT.	7,500	\$ 120.00	\$ 900,000
ROADWAY ITEMS SUBTOTAL					\$ 970,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 146,000
SUBTOTAL					\$ 1,116,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 11,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 11,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (6%)	COST	6%		\$ 67,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 11,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 22,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 11,000
SUBTOTAL					\$ 1,249,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 125,000
SUBTOTAL					\$ 1,374,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 206,000
951X002	CONTINGENCY	COST	5%		\$ 69,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 71,000
ROADWAY ITEMS					\$ 1,720,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 138,000
	RIGHT-OF-WAY	L.SUM			\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 138,000

Summary	
Section	Total
ROADWAY ITEMS	\$1,720,000
PROJECT WIDE	\$
OTHER COST	\$138,000
Total Project Cost	\$1,900,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: WIDE MEDIAN (MP 310.2) NB

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE CULVERT UNDERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
2020014	REMOVAL OF STRUCTURES (EXST PIPE CULVERT)	L.SUM	1	\$ 5,000.00	\$ 5,000
2020301	ROADWAY EXCAVATION	CU.YD.	2,000	\$ 10.00	\$ 20,000
80xxxxx	LANDSCAPING	L.SUM	1	\$ 50,000.00	\$ 50,000
99xxxxx	CONCRETE ARCH STRUCTURE	L.FT.	120	\$ 10,000.00	\$ 1,200,000
ROADWAY ITEMS SUBTOTAL					\$ 1,695,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 254,000
SUBTOTAL					\$ 1,949,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 19,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 19,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (15%)	COST	15%		\$ 292,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 19,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 39,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 19,000
SUBTOTAL					\$ 2,356,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 236,000
SUBTOTAL					\$ 2,592,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 389,000
951X002	CONTINGENCY	COST	5%		\$ 130,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 135,000
ROADWAY ITEMS					\$ 3,246,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 260,000
	RIGHT-OF-WAY	L.SUM			\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 260,000

Summary	
Section	Total
ROADWAY ITEMS	\$3,246,000
PROJECT WIDE	\$
OTHER COST	\$260,000
Total Project Cost	\$3,500,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: RED HILL SCENIC OVERLOOK (MP 311.7)

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE BRIDGE OVERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
2030900	BORROW (IN-PLACE)	CU.YD.	10,000	\$ 3.00	\$ 30,000
80xxxxx	LANDSCAPING	L.SUM	1	\$ 50,000.00	\$ 50,000
99xxxxx	STRUCTURE	SQ.FT.	18,000	\$ 120.00	\$ 2,160,000
ROADWAY ITEMS SUBTOTAL					\$ 2,240,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 336,000
SUBTOTAL					\$ 2,576,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 26,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 26,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (6%)	COST	6%		\$ 155,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 26,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 52,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 26,000
SUBTOTAL					\$ 2,887,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 289,000
SUBTOTAL					\$ 3,176,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 476,000
951X002	CONTINGENCY	COST	5%		\$ 159,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 165,000
ROADWAY ITEMS					\$ 3,976,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 318,000
	RIGHT-OF-WAY	L.SUM			\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 318,000

Summary	
Section	Total
ROADWAY ITEMS	\$3,976,000
PROJECT WIDE	\$
OTHER COST	\$318,000
Total Project Cost	\$4,300,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: ROCKY PARK MEADOW (MP 314.4)

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE BRIDGE OVERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
2030900	BORROW (IN-PLACE)	CU.YD.	10,000	\$ 3.00	\$ 30,000
80xxxxx	LANDSCAPING	L.SUM	1	\$ 50,000.00	\$ 50,000
9140155	RETAINING WALL (CONCRETE)	SQ.FT.	4,000	\$ 60.00	\$ 240,000
99xxxxx	STRUCTURE	SQ.FT.	20,250	\$ 120.00	\$ 2,430,000
ROADWAY ITEMS SUBTOTAL					\$ 2,750,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 413,000
SUBTOTAL					\$ 3,163,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 32,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 32,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (6%)	COST	6%		\$ 190,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 32,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 63,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 32,000
SUBTOTAL					\$ 3,544,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 354,000
SUBTOTAL					\$ 3,898,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 585,000
951X002	CONTINGENCY	COST	5%		\$ 195,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 202,000
ROADWAY ITEMS					\$ 4,880,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 390,000
	RIGHT-OF-WAY (ASSUMED ZERO COST FOR CNF EASEMENT)	ACRES	0.5		\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 390,000

Summary	
Section	Total
ROADWAY ITEMS	\$4,880,000
PROJECT WIDE	\$
OTHER COST	\$390,000
Total Project Cost	\$5,300,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: ROCKY PARK TI (MP 315.6), SCHNEBLY HILL RD TI (MP 320.5), NEWMAN PARK TI (MP 328.8)

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE DUAL USE TRAFFIC-WILDLIFE BRIDGE UNDERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
80xxxxx	LANDSCAPING	L.SUM	-	\$ 50,000.00	\$ -
99xxxxx	STRUCTURE	SQ.FT.	3,000	\$ 140.00	\$ 420,000
ROADWAY ITEMS SUBTOTAL					\$ 420,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 63,000
SUBTOTAL					\$ 483,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 5,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 5,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (6%)	COST	6%		\$ 29,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 5,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 10,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 5,000
SUBTOTAL					\$ 542,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 54,000
SUBTOTAL					\$ 596,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 89,000
951X002	CONTINGENCY	COST	5%		\$ 30,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 31,000
ROADWAY ITEMS					\$ 746,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 60,000
	RIGHT-OF-WAY	L.SUM			\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 60,000

Summary	
Section	Total
ROADWAY ITEMS	\$746,000
PROJECT WIDE	\$
OTHER COST	\$60,000
Total Project Cost	\$800,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: SKELETON PARK (MP 319.2) (CULVERT OPTION)

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE CULVERT UNDERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
2020014	REMOVAL OF STRUCTURES (EXST BOX CULVERT)	L.SUM	1	\$ 50,000.00	\$ 50,000
2020301	ROADWAY EXCAVATION	CU.YD.	10,000	\$ -	\$ -
2030900	BORROW (IN-PLACE)	CU.YD.	100,000	\$ 3.00	\$ 300,000
5010060	PIPE, CORRUGATED METAL, 78"	L.FT.	(215)	\$ 300.00	\$ (64,500)
80xxxxx	LANDSCAPING	L.SUM	-	\$ 50,000.00	\$ -
9050001	GUARD RAIL, W-BEAM, SINGLE FACE	L.FT.	-	\$ 20.00	\$ -
9140155	RETAINING WALL (CONCRETE)	SQ.FT.	2,000	\$ 60.00	\$ 120,000
99xxxxx	BOX CULVERT EXTENSION (8x7)	L.FT.	(45)	\$ 750.00	\$ (33,800)
99xxxxx	CONCRETE ARCH STRUCTURE	L.FT.	150	\$ 10,000.00	\$ 1,500,000
ROADWAY ITEMS SUBTOTAL					\$ 2,292,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 344,000
SUBTOTAL					\$ 2,636,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 26,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 26,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (15%)	COST	15%		\$ 395,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 26,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 53,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 26,000
SUBTOTAL					\$ 3,188,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 319,000
SUBTOTAL					\$ 3,507,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 526,000
951X002	CONTINGENCY	COST	5%		\$ 175,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 182,000
ROADWAY ITEMS					\$ 4,390,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 351,000
	RIGHT-OF-WAY	L.SUM			\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 351,000

Summary	
Section	Total
ROADWAY ITEMS	\$4,390,000
PROJECT WIDE	\$
OTHER COST	\$351,000
Total Project Cost	\$4,700,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: SKELETON PARK (MP 319.2) (BRIDGE OPTION)

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE BRIDGE UNDERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
2020014	REMOVAL OF STRUCTURES (EXST BOX CULVERT)	L.SUM	1	\$ 50,000.00	\$ 50,000
2020301	ROADWAY EXCAVATION	CU.YD.	10,000	\$ -	\$ -
2030900	BORROW (IN-PLACE)	CU.YD.	125,000	\$ 3.00	\$ 375,000
5010060	PIPE, CORRUGATED METAL, 78"	L.FT.	(215)	\$ 300.00	\$ (64,500)
80xxxxx	LANDSCAPING	L.SUM	-	\$ 50,000.00	\$ -
9050001	GUARD RAIL, W-BEAM, SINGLE FACE	L.FT.	1,000	\$ 20.00	\$ 20,000
99xxxxx	BOX CULVERT EXTENSION (8x7)	L.FT.	(45)	\$ 750.00	\$ (33,800)
99xxxxx	STRUCTURE	SQ.FT.	12,000	\$ 140.00	\$ 1,680,000
ROADWAY ITEMS SUBTOTAL					\$ 2,027,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 304,000
SUBTOTAL					\$ 2,331,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 23,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 23,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (15%)	COST	15%		\$ 350,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 23,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 47,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 23,000
SUBTOTAL					\$ 2,820,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 282,000
SUBTOTAL					\$ 3,102,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 465,000
951X002	CONTINGENCY	COST	5%		\$ 155,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 161,000
ROADWAY ITEMS					\$ 3,883,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 311,000
	RIGHT-OF-WAY	L.SUM			\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 311,000

Summary	
Section	Total
ROADWAY ITEMS	\$3,883,000
PROJECT WIDE	\$
OTHER COST	\$311,000
Total Project Cost	\$4,200,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: MUNDS WASH (MP 323.4)

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE CULVERT UNDERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
2020301	ROADWAY EXCAVATION	CU.YD.	10,000	\$ 10.00	\$ 100,000
2030900	BORROW (IN-PLACE)	CU.YD.	60,000	\$ -	\$ -
80xxxxx	LANDSCAPING	L.SUM	-	\$ 50,000.00	\$ -
99xxxxx	BOX CULVERT (3-10x8)	L.FT.	(255)	\$ 1,600.00	\$ (408,000)
99xxxxx	CONCRETE ARCH STRUCTURE	L.FT.	255	\$ 10,000.00	\$ 2,550,000
ROADWAY ITEMS SUBTOTAL					\$ 2,242,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 336,000
SUBTOTAL					\$ 2,578,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 26,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 26,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (15%)	COST	15%		\$ 387,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 26,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 52,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 26,000
SUBTOTAL					\$ 3,121,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 312,000
SUBTOTAL					\$ 3,433,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 515,000
951X002	CONTINGENCY	COST	5%		\$ 172,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 178,000
ROADWAY ITEMS					\$ 4,298,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 344,000
	RIGHT-OF-WAY	L.SUM			\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 344,000

Summary	
Section	Total
ROADWAY ITEMS	\$4,298,000
PROJECT WIDE	\$
OTHER COST	\$344,000
Total Project Cost	\$4,600,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: WILLARD SPRINGS MEADOW (MP 327.4)

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE BRIDGE OVERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
2030900	BORROW (IN-PLACE)	CU.YD.	5,000	\$ 3.00	\$ 15,000
80xxxxx	LANDSCAPING	L.SUM	1	\$ 50,000.00	\$ 50,000
99xxxxx	STRUCTURE	SQ.FT.	19,875	\$ 120.00	\$ 2,385,000
ROADWAY ITEMS SUBTOTAL					\$ 2,450,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 368,000
SUBTOTAL					\$ 2,818,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 28,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 28,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (6%)	COST	6%		\$ 169,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 28,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 56,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 28,000
SUBTOTAL					\$ 3,155,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 316,000
SUBTOTAL					\$ 3,471,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 521,000
951X002	CONTINGENCY	COST	5%		\$ 174,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 180,000
ROADWAY ITEMS					\$ 4,346,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 348,000
	RIGHT-OF-WAY (ASSUMED ZERO COST FOR CNF EASEMENT)	ACRES	0.2		\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 348,000

Summary	
Section	Total
ROADWAY ITEMS	\$4,346,000
PROJECT WIDE	\$
OTHER COST	\$348,000
Total Project Cost	\$4,700,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: JAMES CANYON (MP 330.3)

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE BRIDGE UNDERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
2020301	ROADWAY EXCAVATION	CU.YD.	10,000	\$ 10.00	\$ 100,000
80xxxxx	LANDSCAPING	L.SUM	-	\$ 50,000.00	\$ -
9050001	GUARD RAIL, W-BEAM, SINGLE FACE	L.FT.	1,200	\$ 20.00	\$ 24,000
99xxxxx	BOX CULVERT EXTENSION (2-10x8)	L.FT.	(70)	\$ 1,200.00	\$ (84,000)
99xxxxx	STRUCTURE	SQ.FT.	13,200	\$ 140.00	\$ 1,848,000
ROADWAY ITEMS SUBTOTAL					\$ 1,888,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 283,000
SUBTOTAL					\$ 2,171,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 22,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 22,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (6%)	COST	6%		\$ 130,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 22,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 43,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 22,000
SUBTOTAL					\$ 2,432,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 243,000
SUBTOTAL					\$ 2,675,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 401,000
951X002	CONTINGENCY	COST	5%		\$ 134,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 139,000
ROADWAY ITEMS					\$ 3,349,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 268,000
	RIGHT-OF-WAY	L.SUM			\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 268,000

Summary	
Section	Total
ROADWAY ITEMS	\$3,349,000
PROJECT WIDE	\$
OTHER COST	\$268,000
Total Project Cost	\$3,600,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: KELLY CANYON TI (MP 331.1)

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE BRIDGE OVERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
80xxxxx	LANDSCAPING	L.SUM	1	\$ 50,000.00	\$ 50,000
99xxxxx	STRUCTURE	SQ.FT.	21,000	\$ 120.00	\$ 2,520,000
ROADWAY ITEMS SUBTOTAL					\$ 2,570,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 386,000
SUBTOTAL					\$ 2,956,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 30,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 30,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (6%)	COST	6%		\$ 177,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 30,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 59,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 30,000
SUBTOTAL					\$ 3,312,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 331,000
SUBTOTAL					\$ 3,643,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 546,000
951X002	CONTINGENCY	COST	5%		\$ 182,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 189,000
ROADWAY ITEMS					\$ 4,560,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 365,000
	RIGHT-OF-WAY	L.SUM			\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 365,000

Summary	
Section	Total
ROADWAY ITEMS	\$4,560,000
PROJECT WIDE	\$
OTHER COST	\$365,000
Total Project Cost	\$4,900,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: KELLY CANYON (MP 332.3)

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE BRIDGE UNDERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
2020014	REMOVAL OF STRUCTURES (EXST PIPE CULVERT)	L.SUM	1	\$ 10,000.00	\$ 10,000
2020301	ROADWAY EXCAVATION	CU.YD.	10,000	\$ -	\$ -
5010055	PIPE, CORRUGATED METAL, 72"	L.FT.	(310)	\$ 240.00	\$ (74,400)
5010065	PIPE, CORRUGATED METAL, 84"	L.FT.	(45)	\$ 350.00	\$ (15,800)
80xxxxx	LANDSCAPING	L.SUM	-	\$ 50,000.00	\$ -
8101007	EROSION CONTROL (RIPRAP)	CU.YD.	20	\$ 100.00	\$ 2,000
9050001	GUARD RAIL, W-BEAM, SINGLE FACE	L.FT.	1,200	\$ 20.00	\$ 24,000
99xxxxx	STRUCTURE	SQ.FT.	14,400	\$ 140.00	\$ 2,016,000
ROADWAY ITEMS SUBTOTAL					\$ 1,962,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 294,000
SUBTOTAL					\$ 2,256,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 23,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 23,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (6%)	COST	6%		\$ 135,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 23,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 45,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 23,000
SUBTOTAL					\$ 2,528,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 253,000
SUBTOTAL					\$ 2,781,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 417,000
951X002	CONTINGENCY	COST	5%		\$ 139,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 144,000
ROADWAY ITEMS					\$ 3,481,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 278,000
	RIGHT-OF-WAY	L.SUM			\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 278,000

Summary	
Section	Total
ROADWAY ITEMS	\$3,481,000
PROJECT WIDE	\$
OTHER COST	\$278,000
Total Project Cost	\$3,800,000

Arizona Department of Transportation
Estimated Engineering Construction Cost
Concept Level Estimate

Project Number: 17 YV 298 H6960 01L
Location: JCT SR 179 TO I-40

WILDLIFE CROSSING STRUCTURE: SOUTH OF KACHINA VILLAGE TI (MP 333.1)

INCREMENTAL COST OVER IDCR IMPROVEMENTS TO PROVIDE WILDLIFE BRIDGE OVERCROSSING

ROADWAY ITEMS

Item No	Item Description	Unit	Quantity	Unit Price	Amount
2030900	BORROW (IN-PLACE)	CU.YD.	2,000	\$ 3.00	\$ 6,000
80xxxxx	LANDSCAPING	L.SUM	1	\$ 50,000.00	\$ 50,000
99xxxxx	STRUCTURE	SQ.FT.	21,000	\$ 120.00	\$ 2,520,000
ROADWAY ITEMS SUBTOTAL					\$ 2,576,000
934XX01	MISCELLANEOUS WORK (15%)	COST	15%		\$ 386,000
SUBTOTAL					\$ 2,962,000
207XX01	DUST PALLIATIVE (1%)	COST	1%		\$ 30,000
209XX01	FURNISH WATER (1%)	COST	1%		\$ 30,000
701XX01	MAINTENANCE AND PROTECTION OF TRAFFIC (6%)	COST	6%		\$ 178,000
810XX01	EROSION CONTROL AND POLLUTION PREVENTION (1%)	COST	1%		\$ 30,000
924XX02	CONTRACTOR QUALITY CONTROL (2%)	COST	2%		\$ 59,000
925XX01	CONSTRUCTION SURVEYING AND LAYOUT (1%)	COST	1%		\$ 30,000
SUBTOTAL					\$ 3,319,000
901XX01	MOBILIZATION (10%)	COST	10%		\$ 332,000
SUBTOTAL					\$ 3,651,000
951X001	CONSTRUCTION ENGINEERING	COST	15%		\$ 548,000
951X002	CONTINGENCY	COST	5%		\$ 183,000
951X010	INDIRECT COST ALLOCATION (5.19%)	COST	5.19%		\$ 189,000
ROADWAY ITEMS					\$ 4,571,000

OTHER COST

	FINAL DESIGN COSTS (8%)	COST	8%		\$ 366,000
	RIGHT-OF-WAY	L.SUM			\$ -
	UTILITIES	L.SUM			\$ -
OTHER COST					\$ 366,000

Summary	
Section	Total
ROADWAY ITEMS	\$4,571,000
PROJECT WIDE	\$
OTHER COST	\$366,000
Total Project Cost	\$4,900,000

APPENDIX W4

PROJECT CORRESPONDENCE, FIELD REVIEW AND TEAM MEETING MINUTES

- 1. Recommendations for Wildlife Crossing Structures and Fencing, AGFD, August 3, 2007**
- 2. Field Review Meeting December 18, 2007**
- 3. TAC Meeting April 21, 2008**
- 4. Field Review Meeting April 23, 2009**
- 5. TAC Meeting March 17, 2010**
- 6. TAC Meeting June 1, 2011**
- 7. Field Review Meeting June 28, 2011**



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Mary Schnack
ADOT
Communications Specialist
270 Last Wagon Drive
Sedona, Arizona

August 3, 2007

Dear Ms. Schnack:

We are writing to comment on the ADOT engineering and environmental study on the Interstate 17 corridor between mileposts 298 and 340. As you are aware, this stretch of I 17 has a significant number of elk-vehicle collisions. Our comments are focused on reducing the number of elk-vehicle collisions. I asked Norris Dodd and Jeff Gagnon for their help in drafting comments and recommendations for this project. What follow are primarily their recommendations building on what they have learned in cooperative research with ADOT.

Recommendations for Wildlife Crossing Structures and Fencing along Interstate 17: State Route 179 (MP 299) to Interstate 40 (MP 340).

The stretch of I-17 from SR 179 to I-40 averages close to 70 wildlife-vehicle collisions a year, primarily with elk (ADOT NR, Stanley Consultants Inc.). Collisions with elk can cause substantial property damage, serious injury or death to motorists. Predicted increases in traffic levels and widening of the current highway will likely increase collision with wildlife and exacerbate the barrier effect of the highway to wildlife. Efforts to mitigate collisions while still allowing animals to move across the highway corridor should be considered during this upgrade.

The State Route 260 Project (SR260) is an ongoing project to monitor elk movements, reduce wildlife-vehicle collisions and evaluate effectiveness of wildlife crossing structures and associated ungulate-proof fencing (Dodd et al. 2007). Insight gained from the SR260 project, combined with other research throughout the nation, allow us to make decisions on effective placement of wildlife crossing structures and fencing along I-17.

Due to the safety concerns associated with elk-vehicle collisions, a majority of these recommendations focus on placement of crossing structures to accommodate elk, however, video monitoring conducted on SR260 indicate that a variety of large and small wildlife species will use these structures to safely cross the highway (Dodd et al. 2007).

Arizona Game and Fish Department has been funded by ADOT Transportation Research Center to conduct a study on elk movements. Elk will be fitted with GPS collars adjacent to the highway corridor. Our study encompasses all of the areas along I-17 exhibiting high incidences of elk-vehicle collision. Our 30-mile study area will extend from the Stoneman Lake TI (MP 309) and continue north to Flagstaff, near the I-40 TI (MP

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339). The study will begin in late fall of 2007. Data obtained from these collars will be extremely valuable in determining site-specific placement of wildlife crossing structures and associated elk-proof fencing.

The proposed section of highway to be upgraded can be partitioned into three major areas based on species composition, seasonal movements and geographical features.

Sedona TI (MP 299) to Stoneman Lake TI (MP 306)

Collisions with elk in this area are minimal, although some do occur particularly in the winter months, <1% of all elk-vehicle collisions from 1989-2003 (ADOT NR) were documented along this section of highway. Although safety concerns associated with wildlife-vehicle collisions along this stretch of are minimal relative to the overall project, efforts to reduce road kill and maintain habitat connectivity for other wildlife species should be considered.

When possible, existing culverts should be replaced with a bridge to accommodate wildlife movements. Wing fences should be included to funnel wildlife to these structures.

Stoneman Lake TI (MP 306) to Top of Mogollon Rim (MP 312)

This area consists of relatively rough terrain, and reaches peaks in elk-vehicle collisions when the migratory road moves off the top of the Mogollon Rim. The highest of these peaks is just north of Rattlesnake Canyon. No opportunities exist to retrofit existing structures. Upgrades to the highway will likely increase collisions in this area while further limiting habitat connectivity. At least two large crossing structures should be considered in this 6-mile stretch of highway. Final site-specific placement of these crossing structure locations will be identified following completion of the ADOT/ AGFD I-17 Elk Movement Study to begin in Fall 2007. When possible, existing culverts should be replaced with a bridge to accommodate wildlife movements. Wing fences should be included to funnel wildlife to these structures.

Top of the Mogollon Rim (MP 312) to I-40 (MP340)

A majority of the elk-vehicle collisions (86.3%) occur here constituting the area of highest safety concern for motorists. This area is similar to SR 260 with riparian-meadow and water sources disbursed adjacent to the highway corridor. Wildlife tends to be associated with specific habitats, terrain, and adjacent land use types (Bissonette 2006). In the case of elk in Arizona, results from elk-vehicle collision data, GPS movement data, and habitat factor modeling along the SR 260 project indicate that water sources and riparian-meadow habitat are the driving factors behind the high accident rates along highways (Manzo 2006, Dodd et al. 2007). Elk crossings and elk-vehicle collisions along SR 260 showed definite peaks within close proximity (<1/2 mile) to water/meadow sources, using this information we can identify general areas for some of the wildlife crossing structures.

Preliminary wildlife-vehicle collision data along I-17 shows the same trend of water/meadow association for a majority of the elk-vehicle collision hotspots. This data combined with preliminary modeling can identify general locations for crossing structures and associated fencing. Using a combination of wildlife-vehicle

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collision data, combined with modeling results from the SR 260 project, we suggest crossing structures in proximity to the following general areas:

Kachina Village
Newman Park
Willard Springs
Munds Park
Skeleton Park
Woods Canyon / Clay Park
Rocky Park

Allometric spacing based on elk movement data indicate that maximum permeability will be obtained when crossings of appropriate type and design are placed using the linear home range distance of 2.2 miles (Bissonette 2006). In addition to the structures placed in proximity to water sources and meadows crossing structures should be placed approximately every 2.2 - 3 miles and linked with elk-proof fencing to effectively reduce collisions while maintaining permeability. Final site specific placement of these crossing structure locations and the remaining crossing structure locations will be identified following completion of the ADOT/AGFD I-17 Elk Movement Study to begin in Fall 2007.

Fencing alone will minimize wildlife-vehicle collisions (Clevenger et al. 2001, Dodd et al. 2007), however, this can hinder permeability and habitat connectivity for many wildlife species. Combining fencing with properly designed wildlife underpasses can increase permeability across the highway corridor (Dodd et al. 2007). Final locations of crossing structures and associated fencing will be determined following the analysis of elk movement data. Elk must cross I 17 to reach some of their winter range during winter of moderate to heavy snow.

Combining Crossing Structures with Existing Transportation Interchanges

In some cases locations of existing Traffic Interchanges may coincide with high elk-vehicle collision areas, in these cases expansion of the Traffic Interchanges to accommodate wildlife may be an adequate and cost effective way for reducing collisions while maintaining highway permeability. Success of these dual-purpose structures depends on design, placement, and traffic levels during peak elk movement periods.

If this option is used, these Traffic Interchanges need to be widened to allow natural vegetation and substrate along half of the TI and a separate set of lanes for vehicle access. These Traffic Interchanges should include ungulate-proof fencing to funnel the animals to these structures. Signage should be considered to alert motorists of the dual intent of the crossing structure.

Off ramps at these dual purpose structures require >8' wide cattleguards to keep elk from entering the right of way via the off ramp.

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Use of Existing Bridges as Wildlife Crossing Structures

Currently only the Munds Canyon Bridge (MP 322) constitutes an effective wildlife crossing structure. Fences funneling wildlife to this structure will increase its use.

Future planned upgrades for Woods Canyon Bridge (MP 317.4) should include open-span, natural earthen side design to effectively accommodate wildlife use.

Rattlesnake Canyon (MP 308) culvert is currently not an effective structure to convey wildlife across the highway. Future upgrades should include replacing this culvert with an open-span bridge to accommodate wildlife use.

The access road that passes underneath the highway immediately north of the old Munds Rest Area (approximately MP 323.5) has very low traffic volumes and could likely be simultaneously used as a wildlife crossing structure if upgraded to a bridge and linked with elk-proof fencing. When possible, existing culverts should be replaced with a bridge to accommodate wildlife movements. During the upgrade of SR260, several existing culverts intended for water flow were replaced with open-span bridges. Monitoring of these bridges identified them as effective means for reducing wildlife-vehicle collisions while maintaining highway permeability, when combined with ungulate-proof fencing.

Wildlife Underpass Design

Structural design characteristics and placement of underpasses are important in maximizing their efficacy in promoting wildlife passage. As reported from SR260 and in other studies, wildlife underpass openness is important to achieving high probability of successful crossings by wildlife. Underpass length, the distance that animals must travel through an underpass, is an especially important factor in maximizing their efficacy. Where possible, length should be minimized in designing wildlife underpasses. Atria between underpass bridge spans can contribute to openness, especially for structures exhibiting longer lengths.

The application of concrete walls with ledges in wildlife underpasses should be avoided. Visibility through underpasses should be maximized. Where underpasses are designed for divided highways with atria between bridges, we recommend that the bridges be placed in line such that animal visibility through the structures is maximized. Offset UP bridges should be avoided and used only where the bridges span natural stream courses and drainages; where offset bridges are necessary, the use of fill material that can limit animal visibility should be minimized. Wildlife underpass placement should avoid concentrated areas of human disturbance or congregation that occur at nighttime.

Recommendations for Fencing Type

Several options exist for fencing to designed to funnel animals to underpasses:

One option that will address the safety issue is a "semi-permeable" elk-proof fence. This type of fence is essentially an 8-foot right-of-way fence (10ft T-posts) with a smooth bottom wire, at a recommended wildlife

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friendly height with barbed wire to the top. This style of fence addresses the safety concerns of elk-vehicle collisions while allowing most other species to move freely across the highway, not increasing the barrier effect of the highway. This style of fence decreased accidents by >85% while simultaneously increasing permeability for elk along a stretch of SR260 (Dodd et al. 2007).

Other options include – ungulate-proof fencing, and a new style of safety approved electric fencing that have both proven effective along the SR260 study area.

Escape Ramps/ Slope Jumps

We recommend at least two methods of escape per mile in the event that elk or deer enter the highway corridor. Elk ramps between 5 ½ and 6 ½ feet tall appear to be the best option for allowing elk and deer to leave the right of way based on video monitoring along SR260. Slope-jumps may also be used if the terrain allows. Designs for each type exist.

Post Construction Monitoring

Very little research has been conducted along high-traffic volume highways; studies should be conducted following the widening of the highway to determine changes, if any, in highway permeability and wildlife-vehicle collision rates.

The data collected during the joint ADOT/AGFD “I-17 Elk Movements Associated with a High-Traffic Highway Interstate-17, Arizona” will provide valuable baseline information for these future studies.

Sincerely Yours

Richard Miller
Region II Habitat Program Manager

Literature Cited:

Bissonette J. A. 2006. Evaluation of the use and effectiveness of wildlife crossings. Interim report. National Cooperative Highway Research Program Project No. NCHRP 25-27 FY04.

Clevenger A. P., B. Chruszcz, and K. Gunson. 2001. Highway mitigation fencing reduces wildlife-vehicle collisions. *Wildlife Society Bulletin* 29:646-653



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Dodd, N. L., J. W. Gagnon, S. Boe, A. L. Manzo, and R. E. Schweinsburg. 2007. Evaluation of measures to minimize wildlife-vehicle collisions and maintain permeability across highways; State Route 260, Arizona, USA. Final Report for Projects JPA 01-152 and 04-024T. Submitted to Arizona Department of Transportation, Phoenix, USA.

Manzo, A. L. 2006. An ecological analysis of environmental parameters influencing Rocky Mountain elk crossings of an Arizona highway. Thesis, Northern Arizona University, Flagstaff, USA.

Stanley Consultants, Inc. 2007. Traffic Technical Memorandum No. 1 – crash data for I-17 Jct. SR 179 to Jct. I-40 MP 266-340. Report submitted to Arizona Department of Transportation for ADOT Project No. 17 YV 299 H6960 01L and Federal Project No. STP-017. Phoenix, Arizona, USA.



Meeting Minutes

Meeting Date: December 18, 2007
Distribution Date: January 14, 2008
Meeting Location: ADOT Little Antelope Maintenance Yard
Start Time: 10 a.m. **End Time:** 5 p.m.
Meeting Topic: Wildlife Connectivity
Participants: Norris Dodd, AGFD
Jeff Gagnon, AGFD
Rick Miller, AGFD
Henry Provencio, Coconino National Forest
Justin White, ADOT EPG Flagstaff
Siobhan Nordhaugen, ADOT Natural Resources
Mike Steward, ADOT Natural Resources
Hannah Telle, ADOT Natural Resources
Manuel Sanchez, FHWA
Brian Scott, Stanley Consultants
Thomas C. Ashbeck, EcoPlan Associates, Inc.
Patrick E.T. Dockens, EcoPlan Associates, Inc.
From: Donald C. Smith
Copy: Participants
Prakash Kamdar, ADOT Predesign
Jackie Noblitt, Stanley Consultants
Jessica Walsh, ADOT EPG Flagstaff
Audra Merrick, ADOT Flagstaff Development
Chuck Howe, ADOT Flagstaff District
George Wallace, ADOT Flagstaff District
Steve Thomas, FHWA
Federal Aid No.: NH-017-B(AUC)
Project No.: 017 YV 298 H6960 01L
EcoPlan No.: 06-883
Project Name: I-17, Jct. SR 179 to I-40 (MP 298.5 to MP 340.0)

Interstate 17 (I-17) from State Route (SR) 179 to Interstate 40 (I-40) averages 70 vehicle/wildlife strikes per year, primarily with elk. Expected traffic level increases and planned highway widening

December 18, 2007
Page 2 of 5

projects could increase future strike rates along I-17. The study area can be separated into three segments based on strike rate data compiled by Stanley Consultants (Stanley Consultants, Inc., 2007) and summarized by the Arizona Game and Fish Department (AGFD) (AGFD 2007).

- Sedona traffic interchange (TI) (milepost [MP] 299.0) to Stoneman Lake TI (MP 306.0): Less than 1 percent of collisions occur in this segment, and most collisions occur during winter months.
- Stoneman Lake TI to the top of Mogollon Rim (MP 312.0): Approximately 12 percent of vehicle/wildlife strikes occur in this segment, particularly when migrating elk move south from the Mogollon Rim.
- Mogollon Rim to I-40 (MP 340.0): The majority (86 percent) of vehicle/wildlife strikes occur in this segment, which constitutes the area of highest safety concern for the public traveling along I-17.

The purpose of this meeting was to identify, discuss, and prioritize the potential need and locations of wildlife crossings, primarily elk, along the I-17 corridor. These crossings could be constructed in conjunction with roadway improvements to I-17 in the future. The meeting began at approximately 10 a.m. at the Arizona Department of Transportation (ADOT) Little Antelope Maintenance Yard headquarters building.

During the initial discussion, representatives of the AGFD emphasized the use of effective wildlife-proof fencing along the corridor in conjunction with crossings from Stoneman Lake TI northward and fencing already present near the county fairgrounds and Pulliam Airport. The wildlife-proof fencing would direct wildlife movement away from the roadway and toward designated wildlife crossings on I-17. Wildlife crossing locations would be determined using data from wildlife/vehicle accident collision reports and AGFD wildlife tracking activities. Representatives from ADOT emphasized the need for this data to be incorporated into environmental clearance documents in early 2008. Representatives from ADOT Environmental Planning Group encouraged continued coordination between the AGFD and ADOT engineers or their consultants during preparation of the environmental documents and design concept reports.

Attendees reviewed aerial photos of the I-17 corridor during the discussion to determine potential sites for wildlife crossing structures based on existing structures and topography, with emphasis on areas of elevated wildlife/vehicle strikes.

At approximately 12:30 p.m., a field visit was conducted at these potential crossing sites. A summary of each stop follows. Stop numbers refer to numbers on the attached maps.

Stop 1: Schnebly Hill Road TI (MP 320.0)

This underpass has potential for use by wildlife and may be retrofitted to be more wildlife friendly. Retrofitting would create a dual-use underpass that would function as a wildlife crossing while retaining the original use as a vehicle underpass. The more natural the underpass appears, the more likely wildlife would use it as a crossing. Vertical retaining walls could be removed and replaced with sloping grades away from the underpass road. Cattle guards would be necessary to prevent movement along the highway on- and off-ramps.

Stop 2: Southbound scenic overlook (MP 312.6)

The area roughly centered at the site experiences an elevated vehicle/wildlife strike rate. Topography that is conducive to the construction of a wildlife crossing overpass occurs north and south of the overlook. Several areas were discussed for the location of the overpass, and attendees reached a consensus that the best option was south of the overlook between ridges on both sides of I-17, north of where the northbound and southbound lanes diverge.

Stops 3 and 5: Rattlesnake Canyon (southbound MP 307.0 and northbound MP 307.0)

The area experiences high vehicle/wildlife strike rates, particularly during elk migrations, and is surrounded by topography that is conducive to construction of a wildlife crossing overpass. The existing culvert at the Rattlesnake Canyon crossing is currently inappropriate for elk use and may be cost prohibitive to retrofit or replace compared with the construction of an overpass. It was determined at Stop 5 that the topography along the northbound and southbound lanes near Rattlesnake Canyon is conducive to the construction of a wildlife overpass.

Stop 4: Stoneman Lake Road TI (MP 306.0)

The TI may be retrofitted for dual use. In the vicinity of this TI and along the I-17 corridor southward, fewer wildlife/vehicle strikes occur than in segments of I-17 north of the Stoneman Lake Road TI; therefore, wildlife-proof fencing is not necessary southward. Wildlife-proof fencing from the north should include Stoneman Lake Road TI and extend west and east of I-17 to decrease the likelihood that wildlife would travel around the end of the fence and enter the highway. Cattle guards would be installed to prevent movement along the highway on- and off-ramps.

Stop 6: Rocky Park Meadow, northbound side (MP 314.8)

This area would benefit greatly from a wildlife crossing structure. The current topography is not conducive to construction of a wildlife overpass, though fill from other construction projects along I-17 could be used to create the topography required for the overpass. This location should be discussed in more detail during the development of design concept plans and/or final design.

Stop 7: Rocky Park TI (MP 315.0)

The TI may be retrofitted to become dual-use. Dual-use underpasses such as those proposed for this location could include the addition of a “wildlife lane”—a lane outside of the traffic lanes with a natural substrate, such as dirt, that may be more attractive to large animals, such as elk. Cattle guards would be installed to prevent movement along the highway on- and off-ramps.

Stop 8: Woods Canyon Bridge (MP 317.0)

Though the bridge is an effective wildlife crossing as it is currently designed, the rough terrain (e.g., boulders) below Woods Canyon Bridge may limit the potential of this canyon to function as a crossing for elk and other large wildlife. The current open nature of this bridge crossing should be maintained and the canyon terrain improved during future highway improvements. Future improvements should include wildlife fencing on both sides of I-17 that would direct animals to travel beneath the bridge.

Stop 9: Skeleton Park, northbound side (MP 319.4)

The culvert located at Skeleton Park serves as an example of where culvert wingwalls could be constructed to serve as “jump-outs” or places where wildlife trapped in the I-17 corridor behind wildlife-proof fencing could escape while not allowing wildlife to enter the highway corridor.

Stop 11: Munds Canyon Bridge (MP 322.1)

Munds Canyon Bridge is an example of a road structure that functions well as a wildlife crossing. The span is open, the substrate consists of natural terrain, and visibility during use is adequate for wildlife. Future improvements should maintain this design in conjunction with wildlife-proof fencing to funnel animals to the crossing.

Stop 13: Munds Ranch Road (MP 324.4)

This drainage culvert provides an under-highway crossing for Munds Ranch Road. The culvert size is adequate and, if retrofitted to allow more light, such as with an atrium, could serve as a wildlife underpass in conjunction with wildlife-proof fencing.

Stop 14: Willard Springs TI (MP 326.0)

The Willard Springs TI is a good candidate for a dual-use underpass that would require few modifications. The existing underpass provides sloping sides as opposed to vertical retaining walls, is well lit, and is open in nature. Fencing on both sides of I-17 is necessary for the dual-use aspect of this TI to function properly.

Stop 15: Meadow along northbound lanes north of Willard Springs TI (MP 327.1)

This area is a peak vehicle/wildlife strike area and has suitable topography that would favor a wildlife overpass. The location should be discussed further during the improvement design process. Wildlife fencing on both sides of I-17 would be necessary to create an effective crossing.

Stop 18: Kelly Canyon TI (MP 331.0)

This TI supports a traffic overpass. If combined with wildlife-proof fencing, this overpass may create a suitable dual-use wildlife crossing.

Stop 20: Munds Park Road (MP 336.1)

A large culvert allows Munds Park Road to cross beneath I-17. The culvert size is adequate and, if retrofitted to allow more light, such as with an atrium, and with fencing, the culvert may serve as a wildlife underpass. This option may be more difficult at this location due to the nature of the I-17 widening project and current design of the culvert (e.g., cave-like attributes).

Stops 10, 12, 16, 17, and 19 were not mapped due to less potential of these locations to function as wildlife crossings. However, a short description of each follows.

Stops 10 and 12: Concrete box culverts (CBC) along northbound lanes (MP 321.3 and MP 323.4)

These CBCs do not currently represent an adequate wildlife crossing, especially for elk. Due to potential construction constraints, it was deemed that the expense of replacing these culverts may be too high, and it is not a viable alternative.

Stop 16: Newman Park TI (MP 328.0)

This TI has a poor design for use as a wildlife underpass; it is poorly lit, has vertical retaining walls, and is generally similar to a CBC. Due to potential construction constraints, there may be little chance that the culvert could be retrofitted for use as a wildlife crossing.

Stop 17: James Canyon Culvert (MP 330.3)

This culvert is too small and poorly lit to serve as a wildlife crossing. Due to potential construction constraints, there may be little chance that the culvert could be retrofitted for use as a wildlife crossing.

Stop 19: Pumphouse Wash (MP 334.3)

This culvert is too small and poorly lit to serve as a wildlife crossing. Due to potential construction constraints, there may be little chance that the culvert could be retrofitted for use as a wildlife crossing. The culvert may lend itself to the construction of a pedestrian underpass.

Citations

AGFD. 2007. Recommendations for wildlife crossing structures and fencing along Interstate 17: State Route 179 (MP 299) to Interstate 40. Letter from Richard Miller, AGFD to Mary Schnack, ADOT, dated August 3, 2007.

Stanley Consultants, Inc. 2007. Traffic technical memorandum No. 1 crash data. ADOT, Phoenix, Arizona.



EcoPlan Associates, Inc.
Environmental Science & Resource Economics

Meeting Minutes

Meeting Date: April 21, 2008
Distribution Date: May 1, 2008 – REVISED May 6, 2008
Meeting Location: ADOT Flagstaff District Office
Start Time: 1 p.m.
Meeting Topic: Wildlife Connectivity
Participants: Steve Thomas, Federal Highway Administration
Prakash Kamdar, ADOT Predesign
Andra Merrick, ADOT Flagstaff Development
John Dalby, ADOT Flagstaff District
Chuck Howe, ADOT Flagstaff District
Jessica Walsh, ADOT Environmental Planning Group
Justin White, ADOT Environmental Planning Group
Rod Wigman, ADOT Flagstaff Public Information Officer
Siobhan Nordhaugen, ADOT Natural Resources Management Group
Andi Rogers, Arizona Game and Fish Department
Norris Dodd, Arizona Game and Fish Department
Jeff Gagnon, Arizona Game and Fish Department
Ray Schweinsburg, Arizona Game and Fish Department
Jackie Noblitt, Stanley Consultants
Brian Scott, Stanley Consultants
Donald C. Smith, EcoPlan Associates, Inc.
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John Harper, ADOT Flagstaff District Engineer
Federal No.: NH-017-B(AUC)
ADOT No.: 017 YV 298 H6960 01L
EcoPlan No.: 06-883
Project Name: I-17, Jct. SR 179 to I-40 (MP 298.5 to MP 340.0)
Attachment: Agenda

Following introductions, Donald C. Smith began the meeting by recapping the coordination that has occurred to date regarding wildlife connectivity. This effort was started by Jeff Gagnon, Arizona Game and Fish Department (AGFD), when he provided initial recommendations to reduce wildlife-vehicle collisions in October 2007. An office meeting and field review were

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conducted in December 2007 by ADOT, the AGFD, and consultant team members to discuss possible treatments at specific locations to facilitate the movement of elk across Interstate 17 (I-17). Mr. Smith indicated that EcoPlan Associates, Inc. (EcoPlan) was reviewing the minutes from the December meeting, specifically regarding five areas that may have been prematurely considered less feasible for crossing treatments. The group agreed that these areas could be revisited in the field after Stanley Consultants has developed widening alternatives for the I-17 mainline in the next 2 to 3 months. Prior to that meeting, EcoPlan will provide a photo log of the 400+ drainage crossings along the corridor to facilitate the identification of potential sites to visit and discussions of crossing treatments.

The next discussion focused on how the AGFD recommendations would be addressed during the National Environmental Policy Act (NEPA) process. Mr. Smith explained that these recommendations are typically addressed in the NEPA document and the Design Concept Report (DCR), with a commitment made in each document that the specific details of crossing treatments will be addressed during final design. The point was made that we are in the early stages of developing the NEPA document and the DCR and that this process can take a number of years before anything is constructed. The State Route 260, Payson to Heber study was used as an example; the NEPA document was started in 1990 and completed in 2000 with the commitment for addressing conceptual wildlife crossings further during final design. Some design projects were completed, and constructed, between 2001 and 2006, and others have yet to be started. Mr. Smith advised that the same scenario can be expected regarding this project.

Siobhan Nordhaugen, ADOT, asked whether a wildlife accident reduction study was included in the scope of work for the overall study. Jackie Noblitt, Stanley Consultants, indicated it is included, and a separate report will be prepared and distributed after the Initial Design Concept Report is distributed for review. The report will identify potential locations for wildlife crossings, and associated costs, for the preferred alternative for widening I-17.

The AGFD representatives asked for clarification of this process relative to the five I-17 spot improvements, which were presented to the team months ago, because they believed those were the only locations where anything would be considered for improving wildlife movement across I-17. The study team explained that these locations are considered as near-term improvements that would likely be implemented before the mainline widening and emphasized that the same process would be followed relative to developing crossing concepts now and finalizing them during final design.

The AGFD provided the following exhibits/information to the study team:

- A graph showing wildlife-vehicle collisions by milepost from 1989 through 2006. All high-accident locations correspond to areas above the Mogollon Rim that have adjacent wet meadows.
- Roll plots that identified the vegetation communities and AGFD wildlife crossing zones along the corridor. Andi Rogers recommended that the study team request habitat classification information from the Coconino National Forest staff.

- Regarding non-game animals that should be considered, the AGFD indicated that the study team should review the species list from the AGFD Heritage Data Management System.

The remainder of the discussion addressed the following issues relative to wildlife crossings.

- All crossings do not need to be designed for elk. Some treatments at small pipe and box culverts can be used to help small animals (e.g., coyote, bobcat) cross safely under the highway. The AGFD suggested that the team refer to the Web site www.wildlifeandroads.org for more information on wildlife crossings.
- Regarding wildlife overpasses, there is a need to identify a conceptual width of these crossings and the lateral limits of them on each side of I-17 to assess environmental impacts and estimate costs. The group agreed that the topography at specific locations and the species for which the crossing would be designed would likely determine the width and length of such structures. The existing crossings in Banff National Park and the three crossings being designed on US 93 were discussed as examples. The consensus was that the environmental analysis should address the largest footprint to ensure maximum coverage, even if construction costs might be higher.
- Underpasses are as good as overpasses, but overpasses may be more economical, depending on their siting in the topography, such as between ridges on either side of I-17. Replacement of box culverts in the roadway embankment with single- or multi-span bridges should be based on a benefit/cost analysis because it is not economically feasible to do so when a culvert is at the bottom of a 100-foot-deep fill section. It is acceptable to place box culverts just below the roadway and not at the bottom of deep fill sections.
- The AGFD recommended that benches be cut into the side slopes under the Woods Canyon bridges to facilitate elk passage when water is flowing or standing in the wash that passes underneath.

The meeting adjourned at approximately 3 p.m.

Action Items

- Stanley Consultants will develop mainline alignment alternatives in the next 2 to 3 months.
- EcoPlan will coordinate the next field visit and provide photos of the drainage crossings to team members prior to that visit.
- The study team will continue its coordination with ADOT Natural Resources and the AGFD for the remainder of the study.

Meeting Minutes

Meeting Date: April 23, 2009
Meeting Location: ADOT Little Antelope Maintenance Yard
Start Time: 10:00 a.m.
Meeting Topic: Wildlife Connectivity Field Review
Participants: Steve Thomas, Federal Highway Administration
Cecilia Overby, Coconino National Forest
Henry Provencio, Coconino National Forest
Ray Schweinsburg, Arizona Game & Fish Department
Andi Rogers, Arizona Game & Fish Department
Jeff Gagnon, Arizona Game & Fish Department
Kevin Kozel, ADOT Predesign
Pat Mahoney, ADOT Roadway Design
Rod Wigman, ADOT Flagstaff District PIO
John Dalby, ADOT Flagstaff District
Chuck Howe, ADOT Flagstaff District
Raegan Ball, ADOT Environmental Planning Group
Siobhan Nordhaugen, ADOT Natural Resources Management Group
Steven Ogburn Aztec
Norris Dodd, Aztec
Brian Scott, Stanley Consultants
Tom Ashbeck, EcoPlan Associates, Inc.
Donald C. Smith, EcoPlan Associates, Inc.
From: Donald C. Smith
Copy: Participants
John Harper, ADOT Flagstaff District Engineer
Prakash Kamdar, ADOT Predesign Section
Federal No.: NH-017-B(AUC)
ADOT No.: 017 YV 298 H6960 01L
EcoPlan No.: 06-883
Project Name: I-17, Jct. SR 179 to I-40 (MP 298.5 to MP 340.0)
Attachments: Meeting Agenda & Handouts, Woods Canyon Alternatives Figures

Following introductions, Donald C. Smith gave an overview of the coordination to date regarding wildlife connectivity, including the December 2007 field trip on potential wildlife

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crossings and data received from Jeff Gagnon, Arizona Game and Fish Department (AGFD). He indicated that commitments to include wildlife crossings and fencing to improve elk movements would be made in the Design Concept Report (DCR) and environmental assessment (EA), but specific details as to the type of crossing and extent of fencing would be deferred until final design.

Following the overview, the following items were discussed before the field review:

- **Wildlife Collisions:** Jeff Gagnon advised the group about collision data from 2007-2008 (attached) and compared it to previous data from 1999-2006. The new data confirmed previously identified high accident locations, but they also identified other areas besides major canyons and drainages where additional crossings might be considered. From recent tracking information on radio-collared elk, Jeff indicated that Munds Canyon, located at milepost (MP) 322.0, is the only location where elk actually cross under I-17.
- **Wildlife Fence Retrofit Project:** Steven Ogburn advised the group about the project assessment that Aztec will prepare for ADOT's Transportation Enhancement Section regarding fencing types that will be considered between the Munds Park TI and Woods Canyon. Their report will be completed in about a year, and fencing installations will likely begin in fiscal year 2011. An observation was made that the fencing proposed at the Schnebly Hill Road and Fox Ranch Road TIs could serve as test cases for the other TI locations where the team is considering dual use (i.e., vehicles and elk) crossings.

The office meeting adjourned at approximately 11 a.m., at which time the group boarded vehicles and proceeded to the Woods Canyon crossing. At this location, the team discussed the roadway alternatives under consideration and ways to improve this crossing to facilitate elk movements. Additional stops were made prior to the 3:15 p.m. completion of the field review. Most of the locations were identified in the meeting handout (copy attached), but several other locations were suggested by Jeff Gagnon during the site review. The following notes were taken by Brian Scott and Don Smith.

- Stoneman Lake Road TI (MP 306.3): AGFD did not think the dual purpose treatment, in which elk and vehicles would both use a reconstructed underpass, would be very successful here due to the traffic volumes on the crossroad.
- Rattlesnake Canyon (MP 307.0): AGFD suggested installing a structure in the upper reaches of the road embankment to facilitate elk movements through this high accident area. The structure suggested was a 12-foot-high arch with a 50-foot-wide base. An overpass south of the canyon was also discussed, including the footprint impacts on the east and west sides of I-17 and the broad median in between the northbound and southbound overcrossings. Fencing would play a major role in the success of such a crossing.
- Scenic Overlook/Cedar Canyon (MP 311.7): An overcrossing at this location was discussed, including the use of a Conspan type arch structure over the crossing footprint was discussed using the concept drawing that Brian Scott prepared (attached handout). Most agreed this would be a good opportunity to reduce the numbers of accidents at this location.

- Rocky Park Meadow (MP 314.2): The team was puzzled on what to do in this area because the terrain on both sides of I-17 is essentially flat and would not be conducive for an overcrossing unless major earthwork was done to build embankments on both sides. AGFD suggested an overcrossing be considered south of the meadow where the adjacent terrain would better support an over-crossing due to the existing cut slopes. This location would still require substantial earthwork to facilitate a crossing but would be to a lesser degree than the meadow.
- Rocky Park TI (MP 315.6): AGFD thought a single-span bridge with 2:1 side slopes might work in a dual function scenario but also suggested a separate parallel crossing structure with a dirt floor for elk passage. Jeff Gagnon indicated this location would be a lower priority in comparison to the area south of Rocky Park meadow and the Woods Canyon bridges.
- Woods Canyon (MP 317.0): Everyone agreed there's a great opportunity to improve elk movements through this area. AGFD suggested 2:1 side slopes on the embankments leading down from the bridge abutments and incorporating benches in those slopes to optimize elk usage. They also suggested minimizing the use of rail bank protection with gabion baskets because elk will not climb those areas.
- Culvert crossing – approx. MP 319.2: Currently an 8-foot wide by 7-foot high concrete box culvert (CBC) is present. A wider opening for elk passage with the Conspan arch was discussed. This location was identified as a high priority.
- Schnebly Hill Road TI (MP 320.5): This TI is one of the test cases that Aztec will evaluate as part of its enhancement study. It appears to be a likely candidate for dual use.
- CBC @ MP 321.3: The team did not stop here.
- Munds Canyon (MP 322.0): Jeff Gagnon mentioned this is the only area through which radio-collared elk cross I-17, but this area still has a high number of elk strikes. This crossing will be addressed in the Aztec study; the indication is that higher fences would be installed. Aztec will also make recommendations for the length of the fence runs leading to the crossing.
- CBC @ MP 323.4: AGFD recommended a bridge crossing at this location over a bigger culvert treatment and wanted a straight through crossing. To avoid the rocky terrain west of I-17, the crossing would need to be shifted to the south and would require a channel relocation of Corps jurisdictional water. AGFD also suggested that the R/W fence be converted to elk fencing on the east side of the highway, but it would need to be separated from the elk fencing already present on the adjacent private land.
- Munds Ranch Road (MP 324.4): This location was discussed while at the CBC at MP 323.4. Due to the development adjacent to 323.4 (Munds Park), a crossing at MP 324.4 was preferred, given a choice between the two.
- Willard Springs TI (MP 326.2): The team did not stop here. However, it is a possible candidate for a dual use crossing. AGFD recommended and preferred an overcrossing just south of Willard Springs meadow, away from private land. The consultant team members indicated there may be some construction feasibility and cost considerations that could influence the number of overcrossings along the corridor.

- Willard Springs Meadow (MP 327.4): This location is a high strike area, but near private land. AGFD suggested substituting an overcrossing south of the meadow, where the terrain can facilitate construction of such a crossing. An arch structure may blend in with the terrain easier than a girder bridge, especially on the east side where the terrain is lower than on the west.
- Newman Park TI (MP 328.8): The team did not stop here.
- James Canyon Culvert (MP 330.3): With a proposed 8-foot rise in the roadway elevation here, AGFD recommended a structure be substituted, possibly a Conspan-type. Because the drainage analysis does not indicate the existing culvert is undersized, the addition of a wildlife-only structure higher in the embankment was suggested.
- Cut slope at MP 333.1: This site was discussed as a possible overcrossing location due to the terrain on both sides of I-17. AGFD particularly liked this area because it would provide a much needed crossing in a high accident area and would be located away from the private land in the Kachina Village area.
- Kelly Canyon TI (MP 331.1): This location was considered as a lower priority crossing area, especially if the overcrossing to the south would be done. If the TI was revised as a dual use crossing, AGFD suggested a separate crossing structure (with a dirt floor) for elk movement, parallel to the roadway underpass.
- Kelly Canyon (MP 332.3): The existing culvert appeared undersized based on observations of large debris high above the inlet. The drainage analysis indicated the culvert is undersized. Although the canyon has a rocky floor, AGFD indicated the side slopes would provide a satisfactory path for elk passage, and a bridge would be beneficial here.
- Pumphouse Wash (MP 334.3): No crossing was recommended here because of the existing private land, and advancing development, on both sides of I-17.
- Old Munds Hwy (MP 336.1): AGFD agreed with Coconino County's desire, which was expressed at the April 22nd public meeting, that the existing culvert be replaced with a single span structure. AGFD suggested that the embankment east of I-17 would need to be graded to lessen the grade and facilitate elk usage. A suggestion was made for relocating the crossing several hundred feet to the south and realigning the road on both sides to the new crossing location.

The next step will be for the team to identify crossing priorities in relation to the available accident data and preliminary construction costs that will be developed by Stanley Consultants. The evaluation and recommendations will be presented in the Wildlife Accident Reduction Study report, which will be reviewed by the team. The DCR and Draft EA will present the preliminary crossing recommendations and priorities and a commitment for further study in the final design phase.

Meeting Minutes

Meeting Date: March 17, 2010

Meeting Location: ADOT Green Room Video Conference (206 S. 17th Avenue, Phoenix, AZ)
ADOT Flagstaff District Office (1801 S. Milton Road, Flagstaff, AZ)

Start Time: 8:30 a.m.

Meeting Topic: Wildlife Technical Advisory Committee

Participants: Steve Thomas, Federal Highway Administration
Prakash Kamdar, ADOT Roadway Predesign
Ray Schweinsburg, Arizona Game & Fish Department
Andi Rogers, Arizona Game & Fish Department
Jeff Gagnon, Arizona Game & Fish Department
John Dalby, ADOT Flagstaff District
Chuck Howe, ADOT Flagstaff District
Emily Blinkhorn, ADOT Environmental Planning Group
Siobhan Nordhaugen, ADOT Natural Resources Management Group
Jackie Noblitt, Stanley Consultants
Brian Scott, Stanley Consultants
George A. Ruffner, EcoPlan Associates, Inc.

From: George A. Ruffner

Copy: Participants

Federal No.: NH-017-B(AUC)

ADOT No.: 017 YV 298 H6960 01L

EcoPlan No.: 06-883

Project Name: I-17, Jct. SR 179 to I-40 (MP 298.5 to MP 340.0)

Attachments: Meeting Agenda, Options for Reducing Elk-Vehicle Collisions While Maintaining Permeability along Interstate-17

The meeting was facilitated by Chuck Howe. The purpose of the meeting was to define the Technical Advisory Committee (TAC) responsibilities and scope and discuss focus issues and TAC success criteria. The following is a summary of items discussed:

Potential Wildlife Crossing Structure Recommendations, January 2010 Draft

- Supporting data requested; Chuck Howe requests cost breakdown for major items on matrix costs (e.g., structure costs per square foot, earthwork cost). Clarification was provided that the wildlife crossing costs represented incremental costs over and above the roadway improvement costs.
- Some participants recommended elimination of the “recommendations” and “cost” columns from the matrix; others felt that the recommendations and cost estimates are important information for decision makers. Steve Thomas recommended the columns be used in the matrix.
- Some participants feel that the January 2010 draft could be improved upon. No specific improvement items were discussed.

Action Items: TAC to provide comments on the draft matrix (J. Gagnon / C. Howe)

Action Items: Break out estimate (Stanley Consultants)

TAC Structure

- Ongoing AGFD studies will be available in early winter 2010; probable next TAC meeting in November or December 2010.
- Focus of this group could morph into a statewide TAC, along the lines of the Linkages Group.
- Current group will continue to provide recommendations to the study team and ADOT.

Action Items: Schedule next meeting (C. Howe)

Options for Reducing Elk-Vehicle Collisions

- J. Gagnon provided a summary presentation of the ongoing AGFD study.
- Additional results will be available in October 2010; this effort will include identification of data gaps and any recent large-scale landscape changes (e.g., wildfire); it will also provide evaluation of existing opportunities (e.g., fencing at Munds Canyon Bridge).
- The group supports a ‘place-holder’ for flexibility to locate wildlife crossings using a variety of tools during the final design of spot improvements within the study limits. This is a short-term process for the DCR/EA being developed.
- The District will identify projects and the TAC will provide recommendations on specific design elements for spot improvements within the study limits. This is a long-term process.

Action Items: None



Meeting Minutes-Wildlife Tac Meeting

Meeting Date: June 1, 2011
Distribution Date: June 9, 2011
Meeting Location: ADOT Videoconferencing Facilities (Flagstaff and Phoenix)
Start Time: 1:30 pm **End Time:** 4 pm
Meeting Topic: Wildlife TAC Meeting I-17, SR 179 to I-40
Participants:
Phoenix Video Conferencing Center
Prakash Kamdar, ADOT Predesign Project Manager
Emily Blinkhorn, ADOT Environmental Planning
Jim Lemmon, ADOT EPG
Shannon Ford, ADOT EPG
Alan Hansen, FHWA
Scott Sprague, AGFD
Jackie Noblitt, Stanley Consultants
Brian Scott, Stanley Consultants
Tim Wade, EcoPlan Associates, Inc.
Flagstaff Video Conferencing Center
John Dalby, ADOT Flagstaff District
Chuck Gillick, ADOT Flagstaff District
Kurt Harris, ADOT Flagstaff District
Taylor Damin, ADOT Flagstaff District
Justin White, ADOT EPG
Judy Adams, Coconino National Forest
Charlotte Minor, Coconino National Forest
Michele Begay, Coconino National Forest
Jeff Gagnon, Arizona Game and Fish Department
Andi Rogers, Arizona Game and Fish Department
George Ruffner, EcoPlan Associates, Inc.
From: George Ruffner
Federal Aid No.: NH-017-B(AUC)
Project No.: 017 YV 298 H6960 01L
Project Name: I-17, Jct. SR 179 to I-40 (MP 298.5 to MP 340.0)

Interstate 17 (I-17) from State Route (SR) 179 to Interstate 40 (I-40) averages 70 vehicle/wildlife strikes per year, primarily with elk. Expected traffic level increases and planned highway widening

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projects could increase future strike rates along I-17. The study area can be separated into three segments based on strike rate data compiled by Stanley Consultants (2007) and summarized by the Arizona Game and Fish Department (AGFD) (2007).

- Sedona traffic interchange (TI) (milepost [MP] 299.0) to Stoneman Lake TI (MP 306.0): Less than 1 percent of collisions occur in this segment, and most collisions occur during winter months.
- Stoneman Lake TI to the top of Mogollon Rim (MP 312.0): Approximately 12 percent of vehicle/wildlife strikes occur in this segment, particularly when migrating elk move south from the Mogollon Rim.
- Mogollon Rim to I-40 (MP 340.0): The majority (86 percent) of vehicle/wildlife strikes occur in this segment, which constitutes the area of highest safety concern for the public traveling along I-17.

The purpose of this meeting was to discuss the crossing locations and appropriate structure concepts previously identified, maintenance and cost issues associated with the recommended designs, visual considerations and verbiage to be inserted into the final EA in regards to cost and design and adaptive management. The meeting began at approximately 1:30 pm via video conferencing in both the ADOT Flagstaff and Phoenix facilities.

George Ruffner of EcoPlan started the meeting with introductions of each of the attendees in both locations.

AGFD provided a brief outline of how the locations for the crossings were determined initially using the elk and deer strike data. However, they stated now that the data from the elk movement study has been compiled, these data can be utilized to refine the locations. The data obtained from the elk study verified, with two exceptions, that the current recommended crossing locations have been properly placed. The two locations that have to be further investigated are between the Stoneman Lake TI and the Scenic Overlook. A discussion ensued regarding what the data showed in these two locations and the need for additional crossing structures of some type at these locations. In addition, that the use of properly placed exclusionary fencing is a vital component of the entire crossing plan to ensure that wildlife are guided into the structures and there are no "end runs" at the fence terminus. AGFD suggests extending the fencing south to the Stoneman Lake TI.

There was further discussion regarding the findings of various studies regarding the optimum distance between crossing structures to obtain adequate permeability. AGFD recommends the desirable spacing between structures for this project at approximately 2.2 miles.

An AGFD representative suggested that while we have the opportunity to improve the permeability of the highway for elk and deer, that other wildlife species should be considered. A short discussion took place among TAC members and comments were made stating that although we are not targeting other species, that they will benefit from the additional crossings being recommended. Also, that if wildlife fencing is used and smaller existing or newly constructed culverts are tied into the fencing properly, these will also be available for use by smaller species. ADOT has information regarding the current

locations of all culverts within the project reach. The group was also reminded that safety of the motoring public is the primary driver behind this effort.

The next discussion focused on the prioritization of the crossing locations. The question was posed if the TAC was going to prioritize the crossing locations. AGFD representatives expressed concern regarding using prioritization of crossings as a means to take the lower priority ones off the table. They feel that the present recommendations are all part of the package and are all needed to maximize public safety and highway permeability. The discussion ended with the feeling that prioritization is not needed at this time and that as the design process progresses, priorities will be identified. It was felt that designers will have their hands tied if we get too specific with priorities and exact location.

Discussion went back to the need for additional crossings at the two previously identified locations. It was mentioned that one possible crossing that exists now is used for domestic sheep passage and possibly could be improved for wildlife. An investigation regarding whether this can be done in light of the current usage will be conducted.

A lengthy discussion took place at this time regarding the fact that the original matrix was prepared with the assumption that crossings under a bridge structure were preferred. However, further investigation may be needed to explore the possibility of using large concrete arches or overpasses in some locations. The use of these alternative approaches may be a way to reduce both construction and maintenance costs and eliminate some of the negative issues associated with bridge structures.

AGFD expressed concern regarding the viability of the dual use crossings that accommodate both wildlife and motor vehicle traffic. The main concern is the historic use of these traffic interchanges as overnight resting spots for commercial trucks. ADOT mentioned that during the design phase the details of those crossing may change considerably and this issue can be revisited at that time.

ADOT expressed concern over using double cattle guards on the ramps in these locations due to icing problems. AGFD also had concerns but from a wildlife safety standpoint. There was no resolution to this issue regarding their use to exclude elk, deer and cattle from the highway and median. Further discussion and investigation is needed to resolve this issue.

The CNF representatives were asked if there was concern that the enlarged culverts and new wildlife crossings would result in increased illegal off-highway vehicles (OHV) usage. They stated that there are rules in place regarding off road travel and more to come in future forest plans that should address that issue. It was expressed that regardless of exclusionary fencing or prohibitions, if OHV users want to use a crossing or area, they will, even if usage is illegal. Enforcement by CNF will be key.

The issue of scenic impacts was discussed. The CNF representatives were asked how they evaluated the scenic impact issues. They responded that the entire study corridor is (or shortly will be) designated as "retention" and that all new above-grade structures will have an adverse effect. A lengthy discussion took place regarding the scenic impacts of overpasses and underpasses. It was felt that full public disclosure is needed and that in certain areas (e.g., the view of the San Francisco Peaks north of Munds Park) the public will not want any obstructions. However, since automobiles are traveling at a high rate of speed on the highway, for the most part, even overpasses and new bridges may not prove to be too controversial. There just may be a few select critical view areas that need to

be maintained obstruction-free. In spite of these issues, the USFWS service sees no fatal flaws at this time in the current structure placement or recommended designs.

The FHWA representative reminded the TAC that while they are in support of wildlife crossings designed specifically for the passage of wildlife, the expenditure of public dollars on overcrossing structures may not play well with the public. It was suggested that if an overpass is recommended in a certain location, it needs to be supported by facts such as the existing topography would not support an underpass. The EA should clearly discuss issues related to each of the crossing solutions and justifications for same.

The question was asked regarding who the final decision maker is regarding the structure type and location. It was stated that final approval rested with the FHWA.

AGFD reiterated the need for all of the structures and stated that the percentage of animal strike accidents along I-17 is much higher than the national average.

The discussion then moved on to the cost estimates for the various structures. Representatives from Stanley addressed this item. Per input from the TAC, they adjusted the format of the matrix to be consistent with the format which was used on the I-40 document. They also updated the costs based upon new information received since they were originally prepared back in 2010. Indications were that the only cost that increased significantly was the cost of fencing, which almost doubled.

They also broke out the costs for fencing, cattle guards and jump out structures into a separate column from the actual structure and related construction costs.

An AGFD representative said they were bothered by the immense costs of the structures and questioned why they were so much higher than the cost per unit than the US 93 sheep overpasses. It was explained by both the representatives from Stanley and the FHWA that you cannot make this comparison. The costs reflected in the matrix include all associated costs to design and construct the structures. The costs that AGFD were using from the US 93 project did not include all of the associated costs, just the cost of the structure itself. FHWA expressed that, based upon their experience; the costs reflected in the matrix are right on point. It was further pointed out that Stanley used the ADOT data base of recent bids for other highway projects to prepare the matrix.

The AGFD representative stated that they now had a better understanding of what went into the cost preparation portion of the matrix.

It was stated that both the DCR and the EA needed to pay attention to the specific costs for the structures at each location to ensure these are carried forward through the process to actual construction.

AGFD mentioned that they had a cost estimate for concrete arches that they will share with Stanley for their use.

The final discussion item on the agenda was adaptive management. It was stated that we have learned a lot from the SR 260, US 93 and I-40 projects that has been applied and will continue to be applied to

this project. However, adaptive management is not to be construed to mean that once the structure is constructed that if it does not work, we go back and do it over with a different structure. It simply means that throughout the process as new information is received, decisions should be able to be modified taking the information into account. The EA should reflect that flexibility will be needed regarding the crossing solutions as new data are received.

An AGFD representative stated that the current recommendations are all based upon the best information currently available. However, this is constantly being updated.

A question was asked by AGFD if the entire accident reduction study was going to be included in the Initial DCR. It was thought at this time that the study will follow release of the IDCR; however, the recommendations of the study will be included in the Final DCR. The study will likely become an appendix of the FDCR. Sections of AGFD's report may be included in the wildlife accident reduction study as appropriate.

The final question from AGFD was in regards to how to handle the two new areas that have been identified as needing new structures. It was decided that a small group would conduct a site visit to the two locations and determine the recommended structure types and approximate location. The group will go out during the week of June 27th. EcoPlan will coordinate the site visit.

Action Items:

1. EcoPlan will determine if the domestic sheep crossing under the highway near Rattlesnake Canyon can be modified and used as a wildlife passage.
2. EcoPlan will forward the concrete arch cost document received from the AGFD to Stanley for their use.
3. AGFD will forward the cost estimate for a concrete arch from a previous project to EcoPlan and Stanley.
4. EcoPlan will coordinate a site visit for the week of June 27th for key individuals to look at the two new locations where structures may be warranted.



Meeting Minutes-Wildlife TAC Site Visit

Meeting Date: June 28, 2011
Distribution Date: July 7, 2011
Meeting Location: I-17, Stoneman Lake TI
Start Time: 9:00 AM **End Time:** 11:30 AM
Meeting Topic: Wildlife TAC Site Visit, MP 306 - 311
Participants: Brian Scott, Stanley Consultants
Tim Wade, EcoPlan Associates, Inc.
Chuck Gillick, ADOT Flagstaff District
Justin White, ADOT EPG
Taylor Domin, ADOT Intern
Judy Adams, Coconino National Forest
Charlotte Minor, Coconino National Forest
Jeff Gagnon, Arizona Game and Fish Department
From: George Ruffner
Federal Aid No.: NH-017-B(AUC)
Project No.: 017 YV 298 H6960 01L
Project Name: I-17, Jct. SR 179 to I-40 (MP 298.5 to MP 340.0)

The purpose of the site visit was to re-visit locations that may need wildlife crossing structures in addition to what has already been recommended or to re-evaluate the structure type at certain locations.

AGFD provided a brief outline of how the locations for the crossings were determined initially using the elk and deer strike data. However, they stated, now that the data from the elk movement study has been compiled, these data can be utilized to refine the locations. The data obtained from the elk study verified, with two exceptions, that the current recommended crossing locations have been properly placed. The two locations that were visited were between the Stoneman Lake TI and the scenic overlook.

They stated that the data indicates that numerous crossings and attempted crossings were occurring at the area of the wide median just south of the proposed Red Hill (scenic overlook) overpass. The elk seem to be staging in the median with no way to get out without crossing the highway either to the east or west. In addition, there are currently no crossings proposed south of the scenic overlook. Although elk strike data indicates that strikes decrease significantly south of the scenic overlook, there still may be a need to provide one last crossing south of the wide median to allow wildlife that travel

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to the south along any installed exclusionary fencing to cross the highway. Without a crossing, an "end run" situation could occur in this location and strikes may increase.

The first series of stops were at the Rattlesnake Canyon area and the existing sheep crossing structure south of the wide median area between MP 307 and 307.4 (photos 1-3). After much discussion and viewing both the northbound and southbound sides of this location, it was decided that box culverts in this location as currently shown in the evaluation matrix would not be viable as crossing structures due to their extreme length of 180' SB and 205' NB. After discussion among the attendees, it was also determined that the existing sheep crossing structure would not function well as a wildlife crossing. Therefore, replacing the sheep crossings with single-span I-17 bridges was proposed. Potential environmental consequences from removing the sheep crossing culverts would need to be evaluated.

Overall, three options for crossing structures at Rattlesnake Canyon were discussed, with the first two being the most viable. One option would be to construct new highway bridges on both the northbound and southbound sides of the freeway in the high embankment areas, another would be to construct wildlife overpasses in the cut locations just south of the existing canyon near MP 307.0, and the third option would be a combination of a wildlife overpass and a highway bridge structure. If a structure could not be placed in either location, another, less desirable, option would be to erect exclusionary fencing from the southernmost recommended crossing structure all the way to the Stoneman Lake TI.

There were also stops to view the wide median area and the embankments on both the north and southbound sides of the highway (photos 4 - 7). The team observed a 24" pipe culvert at NB MP 309.8 that was identified by AGFD as a desirable location for a wildlife crossing. The terrain to the west dropped off and thus would readily accommodate a larger culvert opening that would be required for a wildlife crossing. However, the terrain to the east was shallow and flat. I-17 may need to be elevated and/or the existing ground may need to be depressed at the east approach to provide vertical clearance.

The next stop was at the proposed Red Hill overpass to view the cut (northbound) side of the proposed structure location (photo 8). This overpass is already listed as crossing structure #4 and is included in the crossing matrix of 6-1-11. This stop was just to view the location to ensure there were no scenic view issues at this location and to provide the TAC members present with an "in the field" view of the area.

The final stop was on the southbound side of the wide median area near MP 310.3 to view the area where a bridge would be located and how it would tie into the northbound bridge and the wash connection between the two.